The AMSAT Journal

Volume ~~17~~ 16 No. 4
July/August 1993

Editor: John Hansen, WA0PTV
Editorial Staff: Walter Daniel, KE3HP
Ron Long, W8GUS

CONTENTS

Mode 'B' Will Fly on Phase 3D 1

Apogee View 3
By Bill Tynan, W3XO

Using RS-12 Mode "K' Anomalous Propagation for DX 4
By Pat Gowen, G3IOR

Phase 3D Spacecraft Construction Activities 10
By Dick Jansson, WD4FAB

Small IS beSteSt 12
By James Miller, G3RUH

AMSAT-NA Activities Update 14
Transcribed by Bill Hook, W3QBC

Heard on the Downlink 22
By John Hansen, WAØPTV

A Case for the 5.8 GHz Band 25
By Graeme Wilson, VK4FXL

Monitoring AO-13 Battery Storage 28
By Graham Ratcliff, VK5AGR

Mode 'B' Will Fly on Phase 3D

Over the past six months the urgent need to locate a qualified builder of the 2 meter transmitter for the Phase 3D spacecraft has been discussed in this Journal and in other forums. Many within AMSAT had become concerned that it would not be possible to locate someone to do the construction in time for Mode UV (known on previous satellites as Mode 'B') to be included on the Phase 3D satellite. Because of the popularity of this mode and the importance attached to it by the AMSAT membership, locating a builder for this transmitter has been given a high priority. AMSAT-UK and AMSAT-NA worked closely together to identify and screen prospective candidates.

In a joint statement issued at the recently completed AMSAT-UK Colloquium, Ron Broadbent, G3AAJ, Honorary Secretary of AMSAT-UK, and Ray Soifer, W2RS, Executive Vice President of AMSAT-NA, announced that a 2-meter downlink transmitter for the Phase 3D satellite is to be designed and built by Mike Dorsett, G6GEJ, as part of the international Phase 3D project team. Mike, who met with project leaders including Karl Meinzer, DJ4ZC, and Dick Jansson, WD4FAB, last week in Marburg, Germany, to discuss technical details, described his proposed design at the Colloquium, held at the University of Surrey on July 29 to August 1, 1993. Mike Dorsett, a longtime member of AMSAT-UK, is a well-known designer of high performance VHF/UHF equipment. Mike's strong technical background will be a welcome addition to the international Phase 3D project team.

Together with the 70cm uplink receiver already planned, this means that there will, indeed, be a Mode UV capability on the new satellite. If all goes as expected, users of Mode B on AO-13 can look forward to improved performance from Phase 3D.

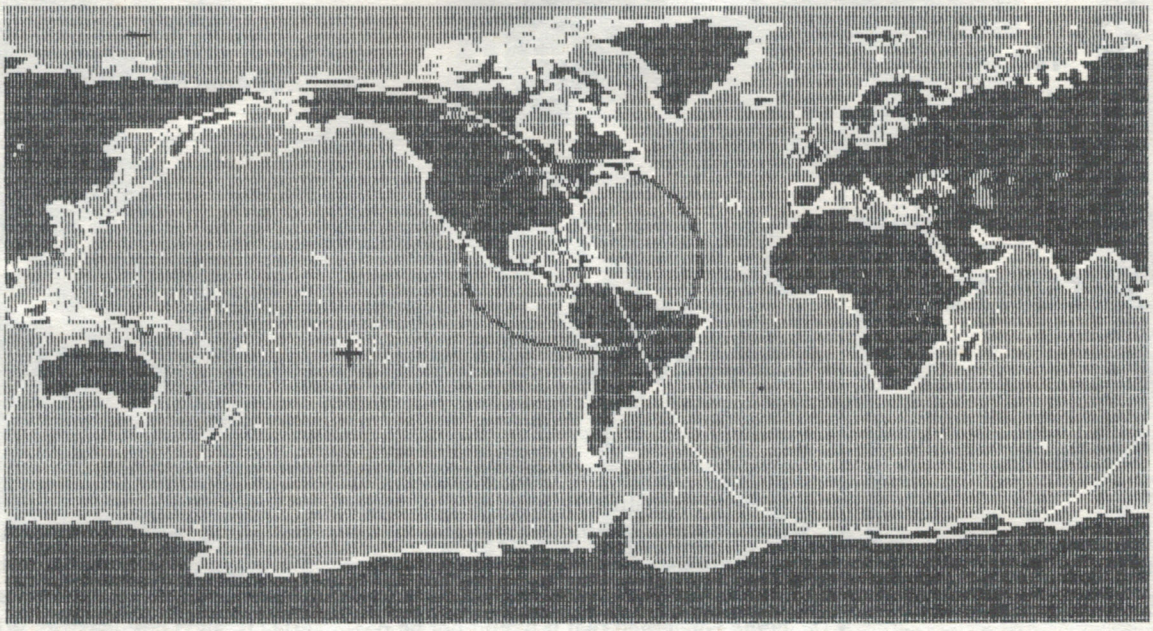
AMSAT-NA
850 Sligo Avenue
Silver Spring, MD 20910

Second Class
POSTAGE PAID
at Silver Spring, MD
and at additional
mailing offices

26557 WB9SGP 94.04
BELTER, STEPHEN
510 ROSE ST.
WEST LAFAYETTE IN 47906

Satellite Tracking

with your PC and the Kansas City Tracker & Tuner



The **Kansas City Tracker** is a hardware and software package that connects between your rotor controller and an IBM XT, AT, or clone. It controls your antenna array, letting your PC track any satellite or orbital body. The **Kansas City Tracker** hardware consists of a half-size interface card that plugs into your PC. It can be connected directly to Kenpro 5400A/5600A or Yaesu G5400B/G5600B rotor controllers. It can be connected to other rotor assemblies using our Rotor Interface Option.

The **Kansas City Tuner** Option provides automatic doppler-shift compensation for digital satellite work. The **Tuner** is compatible with most rigs including Yaesu, Kenwood, and ICOM. It controls your radio thru the radio's serial computer port (if present) or through the radio's up/down mic-click interface. The **Kansas City Tuner** Option is perfect for low-orbit digital satellites like the NOAA and Microsat satellites.

The **Kansas City Tracker** and **Tuner** include custom serial interfaces and do not use your computer's valuable COMM ports. The software runs in your PC's "spare time," letting you run other programs at the same time.

The **Kansas City Tracker** and **Tuner** programs are "Terminate-and-Stay-Resident" programs that attach themselves to DOS and disappear. You can run other DOS programs while your antenna tracks its target and your radios are tuned under computer control. This unique feature is especially useful for digital satellite work; a communications program like PROCOMM can be run while the PC aims your antennas and tunes your radios in its spare time. Status pop-up windows allow the user to review and change current and upcoming radio and antenna parameters. The KC Tracker is compatible with DOS 2.00 or higher.

Satellite and EME Work

The **Kansas City Tracker** and **Kansas City Tuner** are fully compatible with N4HY's QUIKTRAK and with Silicon Solution's GRAFTRAK. These programs can be used to load the **Kansas City Tracker's** tables with more than 50 satellite passes.

DX, Contests, and Nets

Working DX or contests and need three hands? Use the **Kansas City Tracker** pop-up to work your antenna rotor for you. The **Kansas City Tracker** is compatible with all DX logging programs. A special callsign aiming program is included for working nets.

Packet BBS

The **Kansas City Tracker** comes complete with special control programs that allow the packet BBS user or control-op to perform automated antenna aiming over an hour, a day, or a week. Your BBS or packet station can be programmed to automatically solicit mail from remote packet sites.

Vision-Impaired Hams

The **Kansas City Tracker** has a special morse-code sender section that will announce the rotor position and status automatically or on request. The speed and spacing of the code are adjustable.

The **Kansas City Tracker** and **Tuner** packages include the PC interface card, interface connector, software diskette, and instructions. Each Kansas City unit carries a one year warranty. The KC Tuner is not available as an after market upgrade.

- KC Tracker package includes cable for Yaesu/Kenpro 5400/5600 and rotor interface option (to connect to any rotors) $229
- KC Tracker package plus KC Tuner $319
- N4HY QuikTrak software ..... $ 80

Visa and MasterCard accepted.
Shipping and handling: $5, ($20 for international shipments).
Prices subject to change without notice.

NEW ADDRESS!

L. L. Grace
Communications Products
P.O. Box 1345 • Voorhees, NJ 08043 • U.S.A.
For more info: Telephone 609-751-1018
FAX 609-751-9705
CompuServe 72677,1107

10/92

L. L. Grace also manufactures the DSP-12 Multi-Mode Communications Controller. Call or write for more information.

The AMSAT Journal Staff

Editor in Chief: John A Hansen, WAØPTV
Circulation: Martha Saragovitz

AMSAT-NA Board of Directors:

Tom Clark, W3IWI, Dick Daniels, W4PUJ, Junior DeCastro, PY2BJO, Joe Kasser, W3/G3ZCZ, Jan King, W3GEY, Andy MacAllister, WA5ZIB, Bill Tynan, W3XO

AMSAT-NA Officers

President:
Bill Tynan, W3XO
Executive Vice President:
Ray Soifer, W2RS
Vice President Operations:
Keith Pugh, W5IU
Vice President: Field Operations:
Mike Crisler, N4IFD
Vice President: User Services:
Andy MacAllister, WA5ZIB
Vice President of Publications:
Drew Deskur, KA1M
Vice President of Engineering:
Dick Jansson, WD4FAB
Treasurer:
Art Feller, KB4ZJ
Corporate Secretary:
Martha Saragovitz
President Emeritus:
Tom Clark, W3IWI

Editorial Office: **John A. Hansen, WAØPTV, 49 Maple Avenue, Fredonia, NY 14063. Compuserve 70353,460.**

Production Office: Executive Printing Services, Inc., 6640 Ammendale Rd. Beltsville, MD 20705

Advertising Office: AMSAT Headquarters, 850 Sligo Avenue, Silver Spring, MD 20910-4703

AMSAT-NA Headquarters: 850 Sligo Ave., Silver Spring, MD 20910-4703 Telephone: 301-589-6062 (10 AM to 6 PM Eastern). FAX 301-608-3410

T*he AMSAT Journal* (ISSN:1047-3076) is published bi-monthly (Jan, Mar, May, July, Sept, Nov) by AMSAT-NA, 850 Sligo Ave., Silver Spring, MD 20910-4703 Telephone: 301-589-6062. Second Class postage paid at Silver Spring, MD and additional mailing offices. Postmaster: send address changes to *The AMSAT Journal,* 850 Sligo Ave., Silver Spring, MD 20910-4703

Opinions expressed in *The AMSAT Journal* are those of the article author and not necessarily those of AMSAT-NA. Copyright© 1992 by AMSAT-NA, The Radio Amateur Satellite Corporation. AMSAT is a registered trademark. Reproduction of material from *The AMSAT Journal,* mechanical, electronic or photocopy is prohibited unless written permission is obtained from the author.

The AMSAT Journal staff is always interested in article submissions. Text whenever possible should be on MacIntosh or IBM compatible diskette (3-1/2" preferable) with hard copy. AMSAT-NA reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations. The editors of this publication are volunteers giving freely of their talents, time and efforts to produce *The AMSAT Journal.*

The State of AMSAT and Phase 3D

by Bill Tynan, W3XO
President, AMSAT-NA

In reviewing the various letters written to me by AMSAT members over the past year, it has become evident that our membership is becoming more interested in the financial side of AMSAT-NA. Since I became your President in late 1991, I have strived to make information about how your organization operates freely available through a variety of means. Now, with our heavy financial committment to Phase 3D, questions like "How much money does AMSAT have and how is it invested?" "How much has been raised so far in support of Phase 3D, and how much of that has been expended, and for what?" are being asked ever more frequently. Another typical question is "How many paid employees does AMSAT have."

Because you are the ones paying the bills it is important that you also understand just how your support is being used. I'll try, in the next few paragraphs, to answer some of the more frequently asked fiscal questions as best I can. Obviously, a complete financial picture of an organization as large and far-flung as ours cannot be presented in a few page editorial.

First, AMSAT-NA has ONE full time, paid employee. Her name is Martha Saragovitz and she does a fine job of running our office in Silver Spring, Maryland. Martha has worked for AMSAT for 15 years and is the organization's best informed "corporate memory". Many of you have spoken with her by telephone when you called to join, renew, order software or merely ask a question. Those of you who have spoken with her know how hard she works and how well informed she is. In addition to her paid job of Office Manager, Martha also serves the Board of Directors as our Corporate Secretary, which is a volunteer position. We also hire a part-time typist to assist Martha a few hours per week.

ALL of our other officers and workers are VOLUNTEERS. That includes Dick Jansson, WD4FAB, our Vice President for Engineering who puts in many hours per day on mechanical and thermal design for Phase 3D. It includes Dick Daniels, W4PUJ, who keeps the AMSAT-NA Phase 3D efforts coordinated. It includes Ray Soifer, W2RS, our Executive Vice President who helps me stay out of trouble, and acts as our liaison with overseas AMSAT groups. It includes Art Feller, KB4ZJ, our ever-watchful Treasurer. It includes Keith Pugh, W5IU, who keeps the Operations Department running smoothly. It includes Keith Baker, KB1SF, who keeps the Phase 3D work on schedule and has recently been appointed Vice President for Strategic Planning. It includes Bruce Croskey, WA6JCD who, as new Vice President for Development, will be taking the lead on Phase 3D fundraising. It includes Paul Urie, N7QOC, who stepped in last year to take over Editorship of this Journal following a crisis in Drew Deskur's family. It includes John Hansen, WAØPTV, who has now assumed the job of Journal Editor, following Paul's inability to continue due to heavy work commitments. It also includes a whole team of regional and area coordinators who represent AMSAT at hamfests, conventions and club meetings. And, it includes your President and a host of other people who spend many hours per week on AMSAT affairs, because they believe in what we are trying to do for Amateur Radio.

This volunteer effort is not totally without cost. You can't expect people to put out all the effort they do, and have the necessary expenses come out of their family budgets. The organization does have a policy of reimbursing most of the out-of-pocket expenses incurred in the course of performing AMSAT work. The key word here is "reimbursing". That means each volunteer must still make a satisfactory

(continued on page 13)

Using RS-12 Mode 'K' Anomalous Propagation for DX

by Pat Gowen G3IOR

If you thought that Oscar 10 and 13 were the only amateur satellites capable of supporting long-haul DX contacts, you're mistaken. In this paper G3IOR shows how to use the LEO Russian birds for making long distance contacts and once again demonstrates how the Amateur Space Program can contribute to the general body of scientific knowledge.

Originally presented at the 1992 AMSAT-UK Colloquium

For some thirty five years now we have known of sub-horizon audibility of HF satellites. It was October 1957 when Doug Mallett, G3HVL and I became involved in tracking the 20 MHz beacon of the very first man made orbiter, the Soviet SPUTNIK-1. We saw it, we heard it, and like the professionals we could hardly believe it to be possible.

SPUTNIK-1 Anomalies

As requested by various equally amazed authorities, we did the calculations necessary to find the height, inclination and period of SPUTNIK-1, thereby discovering an orbital period of some 41 minutes. We wondered why we could hear SPUTNIK even though we could not see it on alternate orbits. In those days it was presumed that signals from space couldn't penetrate the ionosphere, so we assumed that it just had to be up there somewhere. Without realizing it, we had discovered the first satellite antipodal reception! In fact, the period was some 82 minutes, but we were hearing SPUTNIK when it was over the exact opposite side of the world. Antipodal reception is a satellite phenomena still not fully understood today.

Antipodal reception was not the only oddity generated by SPUTNIK-1. The strange changing of frequency, which we then assumed was due to oscillator voltage variations brought about by temperature changes as SPUTNIK was moving between raw hot sunlight and dark cold space we later found to be the now well understood Doppler effect!

Other Early Sub-Horizon Findings

When OSCAR-6 went aloft on October 15, 1972, Professor Walter Eichensuer, DJ2RE and I both observed excellent sub-horizon propagation from the 29 MHz beacon and transponded signals when the satellite was well below our horizon.

Oscar 9 (UoSAT-1) was the first amateur scientific satellite. Built by the University of Surrey AMSAT Group led then by Martin Sweeting, G3YJO, it went into a 540 Km high circular orbit on October 6, 1981. It carried beacons on 7, 14, 21, 29, 145, 435, 2400, and 10,470 MHz. The 7 MHz beacon was never heard, not even in the minimal MUF times, and it was assumed that this beacon signal could not penetrate the ionosphere. The 14, 21, and 29 MHz beacons were fascinating sub-horizon radiators. Invariably one would first hear the 14 MHz beacon up to some 35 minutes pre-AOS, then the 21 MHz signal some 7 to 14 minutes later, then the 29 MHz beacon, and finally (at the horizon) the 145.825 MHz transmission almost simultaneously with the 435 MHz beacon. Often the HF beacons would be totally attenuated to below the noise when the angle of incidence was low and the maximum traverse through the E and F layers was evident. The 21 MHz beacon propagation varied with the sunspot number, this dictating the solar flux, this dictating the ion pair density and thickness of the layers. High solar flux times gave far earlier 'AOS' than low and also far greater signal extinction at low elevation angles.

The ISKRA II and III amateur radio satellites were built by Moscow Aviation and Space Institute students. The 'K' mode 21 MHz uplink and 29 MHz downlink was developed by Leo Labutin, UA3CR and later included in RS-10/11 and RS 12/13. The ISKRAs were hand launched from SALYUT-7 into a 340 Km circular orbit, the mean height of the F2 layer itself, but the satellites did not stay in orbit long enough to be populated by many amateurs due to the low altitude and high drag. The ISKRA craft nonetheless opened satellite communications up to many amateurs who were unable to meet the cost, frequency requirements or technology demanded by the latter day AMSAT satellites. ISKRA's daytime only signals were found audible at good strength for extended periods when below the listener's horizon, but were frequently absent when the satellites were above the horizon, even at high elevation angles.

Satellite Height and Sub-Horizon

Comparison of various HF satellites at different heights indicated what at first might be thought to be a strange phenomena: the lower the satellite altitude, the better the sub-horizon path. VHF and UHF satellite users are more used to the fact that higher the satellite the further the sub-satellite point at which it is heard. In general a doubling of the horizon limit distance (as seen by the satellite) approximates the maximum communication distance possible at zero degrees elevation at each end of the path. This fact, however, assumes line of sight paths plus a small added amount of time due to reangulation at the tropospheric E and F layers. It is, of course, accurate for VHF, UHF and SHF, but not for HF, as ducting trapping, reflec-

tion and refraction of an active ionosphere can come into play in daylight paths at high MUF times.

Satellite Ionospheric Incidence

Figure 1 shows the height of the various HF transmitting satellites relative to the various active layers. Three different charts are presented for the ionosphere to reflect seasonal and day/night variations. From these charts it is clear that the lower the satellite, the more pronounced the sub-horizon effect. Low satellites such as the ISKRAs or the UoSats provide excellent sub-horizon paths even at mediocre MUF times while the higher orbiters such as RS-1 and RS-2 only effect results at peak solar flux times. The sub-horizon performance of these satellites is depicted in Figure 2, which shows the beacon signal strength both below and above the horizon. Note the lowest satellite of the group, ISKRA, was heard when it was 32 degrees below the horizon, while the early RS birds were acquired at about 2 degrees below the horizon.

When we study the immediate AOS post-horizon and pre-LOS attenuation at both 21 and 29 MHz, we will find it is almost absent at night, but very noticeable in day paths. Thus, we have to consider the satellite track relative to the solar illumination of the E and F layers. The transit time from dark to light or vice verse creates very different propagation conditions for HF satellites, thus this is a further variable to consider.

RS-12/13 on 'K' Mode

Many of the effects discovered can be put to enjoyable use by working DX with the use of 'K' Mode on RS-12. In fact, this mode is the only one that can be employed to work stations at the antipodal point, where even the high-flyers like AO-10 and AO-13 cannot reach! Both the 21 MHz uplink and the 29 MHz downlink are viable for use when the users are situated at points well below the satellite line of sight path, at pre-AOS and post-LOS.

RS-12 and 13 are separate transponders sharing the USSR COMOS 2123 NAVSAT that was launched from Plesetsk on February 5, 1991 into a non-synchronous 82.9 degree 1000 km circular orbit with a 104.8 minute period. In addition to mode 'A' transponders that were flown on previous RS birds, they also carry mode 'K' and 'T' transponders, with uplinks on 15 meters and downlinks on 10 meters and 2 meters. At this time RS-12 is the functioning transponder that is activated on mode 'K' only, with RS-13 being kept on reserve standby. When the NAVSAT carrying RS 10/11 comes into active service, its 150 MHz RTTY-like signal will break through onto the 2 meter receiver input, thus preventing effective mode "A' operation. It will still permit mode 'K' continuity on either of that satellite pair, so that in time RS 12/13 may revert to mode 'A'.

'K' mode communications can be very different from the VHF and UHF satellite operations that we are more used to. While we tend to be geared toward looking for our VHF and UHF birds of interest from 'AOS' to 'LOS', 'K' mode can be exploited and enjoyed when the satellite is well below the user's horizon. Mutual sub-horizon QSO's are possible, as the signals on both uplink and downlink paths are often above or close to the MUF, so allowing major ionospheric re-angulation of both uplink and downlink, especially on dusk to dawn and semi-daylight paths between users and satellite. You will be delighted at what satellite DX you may work on what might otherwise be a very dead band, even over night paths when the sub-horizon DX is minimized. In the first few days of operation I worked 17 countries on RS-12, including W1, 2, 3, 5, 6, 8, 9, Ø, VE1, 2, 3, and 7, PY, UAØ, ZL, plus many European countries and fellow 'G' stations.

Sub-Horizon Experimentation

You will find that at high solar flux times one can both access and hear the transponded return even when the satellite is up to 48 degrees below your horizon, especially when pre-auroral ionospheric enhancement is evidenced.

What is more, you will be able to work stations well beyond the official 'line of sight' to the satellite when it is in direct path range of you. Just how well the paths work was recently explored by Roger Cooke, G3LDI, David Johnson, G3MPN and me.

These three stations all used CW at some 1 KW erp from high gain low angle beams to enable identification and measure tonal degradation. Using 21.214 MHz as an uplink and 29.415 MHz for a downlink, we kept in touch with each other on 145.425 MHz voice FM, so phasing our calls and relaying our downlinks to each other for comparison purposes would be possible.

We first took December and January morning (1992) passes from 80 degrees to 34 degrees azimuth and found that there was little or no pre-AOS audibility of the beacon or our own transponded signals. At AOS plus 2 minutes the 29.407 beacon, severely tonally degraded would come above the band noise. Our own downlinks appeared 3 minutes after 'AOS' as extremely rough hissing notes. As the satellite elevated above our horizon our signal returns improved to about T6, then degraded again, disappearing with the beacon one minute prior to the calculated LOS time. Four minutes after the calculated LOS both the beacon and our transponded returns reappeared simultaneously, the tonal quality rapidly improving all the time. We were able to copy each others signals perfectly, finding the strongest and cleanest signal returns up to 17 minutes post horizon, when the satellite was on the opposite side of the pole heading down the Bering Sea between Alaska and Kamchatka. After this peak the signals then gently weakened to eventually drop below the noise. We found that south to north passes were equally good, but with excellent transponded returns always fading out as RS-12 went over the far tip of Sakhalin Island, when Oceania and the western United States had direct view access.

Multi-Doppler Tonal Degradation

We found over the course of the weeks following that all signals were invariably and consistently a rough 'auroral' hiss at low elevation angles, improving to typical HF auroral and polar flutter returns as the satellite approached the northern LOS horizon, when it disappeared before returning well post-horizon with improving signal strength and tone. Stations to our south tonally degraded first, while GM and G stations to our north stayed almost T9. It was also noted that our 21 MHz signals transponded to the downlink on 29 MHz were far more tonally degraded than the 29.407 MHz beacon or the 29.453 MHz ROBOT.

ROBOT Use

When no stations were active on the transponder due to unsocial hours at the far end of the path, I used the ROBOT to tell us that we were accessing the single frequency transponder at 21 MHz as well as hearing the 29 MHz downlink at these sub-horizon points. Often multi-path scatter destroyed the required precise 1:3 dot-dash morse ratio that the ROBOT demands, but I could monitor for the simultaneous response tone to investigate my 21 MHz signal presence at the uplink receiver. Sometimes I could hear the beacon and ROBOT CQ calls when my own signal was absent. It was of course impossible to see if my own 21 MHz signal was present if no downlink was audible.

Path Plotting By Computer

Participating with us in investigating the test findings, John Branegan, GM4IHJ, generated great circle paths with his computer, shown here as the path 'bird's eye' view in Figure 3. This chart shows as a solid circular line around the UK, the normal AOS or LOS maximum horizon. The broken double radius circle (the middle circle) is an estimate of the first refraction zone as well as the normal DX optimum window. The two tracks plotted as sub-satellite paths showed that we had sub-horizon access first when the satellite was over Novaya Zemlya and then on until it was out over Alaska for the first pass at 1155 UTC AOS and beyond eastern Siberia for the second at 1334 UTC AOS. Note that the largest diameter circle on Figure 3 shows the maximum zone from refraction putting JA, UAØ, KH6, P29, and many more DX spots all within range! Sadly, no one was on the satellite from the other side of the world apart from a few UAØ stations using the uplink band for local USB QSO's. They were not listening for transponded signals on 10 meters and probably had no idea that they were on that band at all!

The 'side view' of the paths, shown in Figure 4, was also generated by GM4IHJ's computer. It showed the parallel view of the signal track at the last moments of satellite access. The dense solar-illuminated ionosphere as far as the northern Russian Federation was able to re-angulate our signals so that they then went through the far thinner ionosphere in darkness further north of the satellite over Alaska.

The return path for the transponded signal also resulted as the satellite downlink signal was able to penetrate through the low attenuation thin ionosphere over Alaska then by earth skimming chordal hop to produce refraction from the underside of the more dense ionosphere between Norway's north cape and the UK.

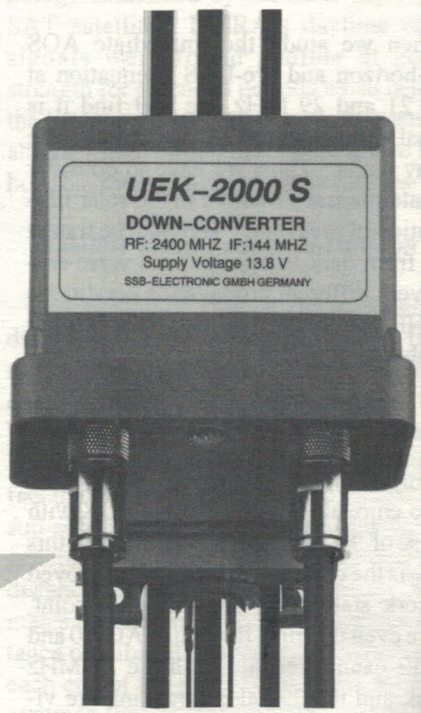
New converters for OSCAR & ARSENE

UEK-2000 S

High performance S-band converters for both satellites

Based upon the requests of the advanced satellite user, we have developed a new "easy to use" converter with these features:

- Super-low noise HEMT-input RF amplifier with a N.F. of < 0.6 dB
- Overall converter N.F. of 0.8 dB, 1.0 dB for mast-mounted version
- 2-pole Helical filter for superb front-end selectivity
- GaAs-Fet second stage preamplifier
- Surface mounted Schottky Double Balanced Mixer (DBM) with 144 MHz IF
- Very stable x-tal oscillator with filter coupled multipler stages
- Teflon-PCB & microwave SMD construction
- Voltage feed via coaxial cable or via separate line
- Different models available for either OSCAR Mode "S" or the new ARSENE
- Mast-mounted versions feature: SS-Hardware, N-Connectors & weatherproof construction
- Non mast-mounted versions are available with neu-silver boxes & SMA connectors
- With a tuneable receiver (144 – 191 MHz), one converter can cover both OSCAR & ARSENE



For more information

on this and over 100 exciting products from SSB Electronic including the new AIRCOM PLUS (10.3 mm) low-loss-semiairspaced 50 Ohm coaxial cable

please contact:

SSB ELECTRONIC GmbH
Panzermacherstr. 5
58644 Iserlohn/Germany
Phone ++49 / 23 71 / 64 54
Fax ++49 / 23 71 / 6 75 93
EUROPE, ASIA, AFRICA

SSB Electronic

SSB ELECTRONIC USA
124, Cherrywood Drive
Mountaintop, PA 18707, USA
Phone ++1 / 717 / 868-5643
Fax ++1 / 717 / 868-6917
AMERICA, AUSTRALIA

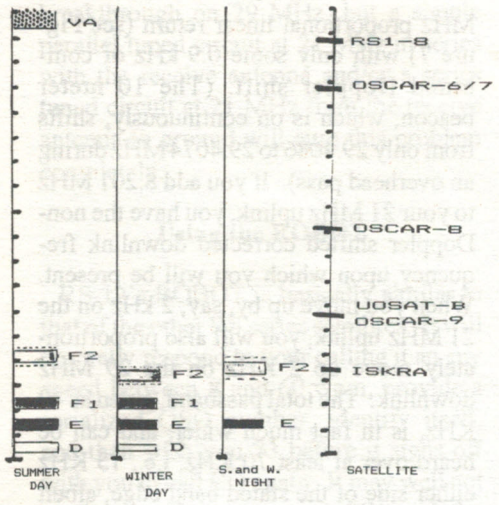


Figure 1:
Satellite Orbital Heights
Ionization Level Heights

Post-Meridian Passes

On a few occasions long after mid-day it was possible to work the western United States. For example, WA6BDA in San Francisco was worked at 1838 UTC on February 17, 1992, when RS-12 was heading up the Pacific Ocean off the US west coast. One pass was heard continuously from Easter Island all the way to Japan for almost an hour. This form of propagation is not so easily explained. While WA6BDA could well have gotten his signal through the ionosphere at 21 MHz and also have heard the return signal on 29 MHz at 0940 local time, it is not necessarily true from G3IOR's end, as at 1840 UK local time he is on the night side of the night/day terminator line. While G3IOR's signal can get to the underside of the ionosphere near San Francisco at the time of high sunspot numbers (162 at that time), he is incident upon that ionosphere at a very oblique angle, as seen in figure 5. It may be noteworthy that G3IOR optimized by using the maximum allowed power to a three element rotary beam pointing to 350 degrees, not the 315 degree great circle path from his QTH in Norfolk to California. This QSO seems to defy the rule that oblique incident signals will only get to RS-12 through the thin night-side ionosphere. It is similar to those times when ISKRA-2 and 3 gave frequent access in the UK afternoons in 1982, so this form of propagation is not new, but its mechanism is yet unexplained.

Late Evening Pass DX Results

In the January, 1992 evenings after 2130 UTC when both the 28 and 21 MHz bands were totally dead on the terrestrial F2 paths, we were able to work W1, 2, 8, and 9 stations, who were employing the same propagation that we had been using earlier in the day over Polar paths. During these late evenings, DX paths to the west were achieved when the satellite was over Eastern Europe. When these US stations were worked, RS-12 was a long way below the American horizon but within normal line of sight of the participating British stations.

The explanation for these paths again came from GM4IHJ, who put his computer to work to explore the MUF produced along the path by plotting the solar terminator points relative to the station pairs and earth-solar time as shown in Figure 6. It shows the terminator at 2142-2152 UTC, with dense ionosphere over the US, but quite absent from Europe. While the American stations would have been able to work stations situated in the mid-Atlantic direct on 21 or 28 MHz, they would not have been able to make QSO's with Europe at this time. The plot shows the 21 MHz uplink signal leaving America, refracting from the sunlit ionosphere over the US eastern seaboard, the propagating downwards to earth, skimming the Atlantic surface, then rising to penetrate the very thin ionization layer to see the satellite over Eastern Europe. The satellite 29 MHz downlink return then follows the reverse path, going through the thin ionosphere to the ionized F2 layer off the US and Canada, to then refract down to the North American stations.

Extrapolated DX Possibilities

Based on this analysis, GM4IHJ points out that had they only been active, it would have been possible to have worked stations right across the US, all the way to the west coast. He recommends that RS-12 Mode 'K' operators should concentrate on two separate patterns:

1) Listening for distant stations beyond and on their own side of the terminator, when they are in daylight and the satellite is just over the night side of the terminator.

2) Listening for distant stations located on the day side of the terminator, when the operator's station is inside the satellite footprint, above the station horizon and the satellite is on the night side of the terminator, but no more than 3000 km from the terminator.

GM4IHJ's calculated paths were put to the test in the following week, with the result that I was able to work a UAØ in

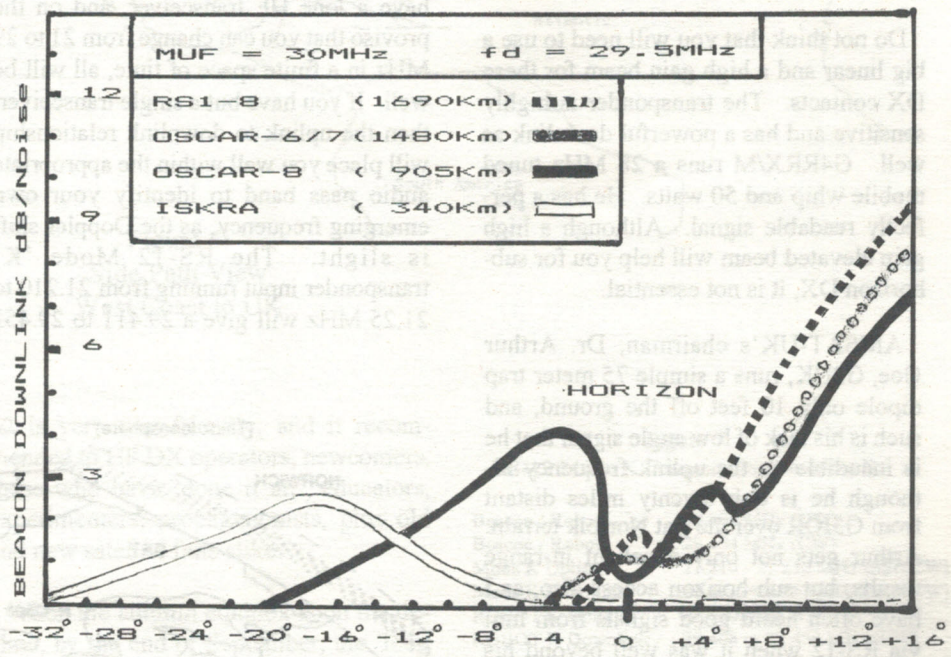


Figure 2:
Signal Strength Before
and After AOS

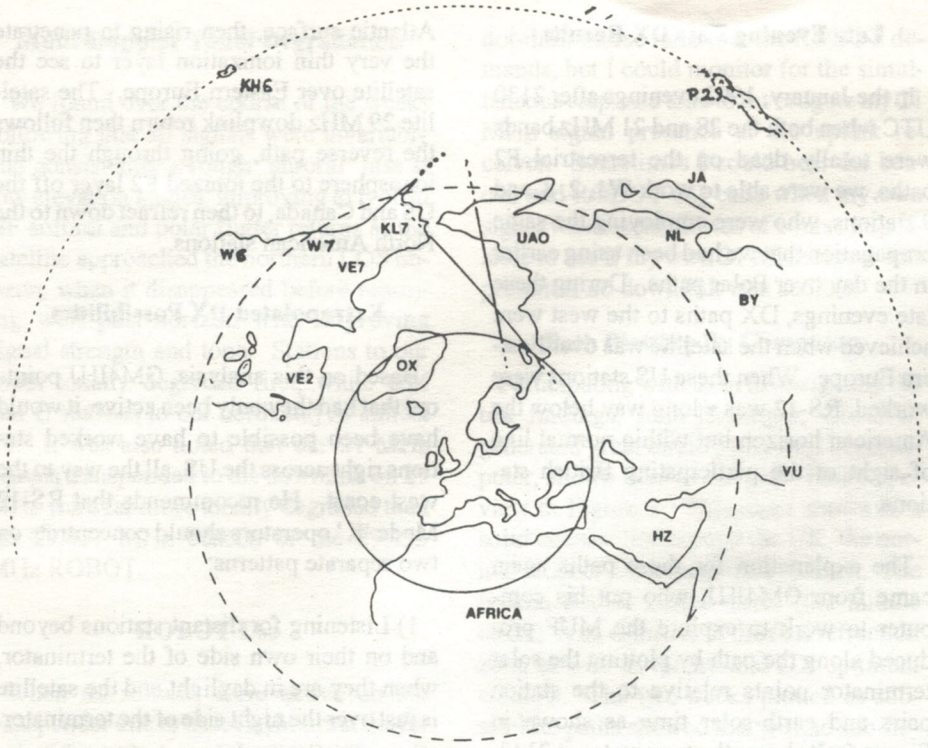


Figure 3:
RS-12 Sub Horizon Paths

zone 19 and WA6BDA in California at the recommended times. LA4XC, the late Harry Jansen, worked JA, while avid SWL Jan Andersen OZ-DR 2197 in Skagen, Denmark has been hearing JA, VE7, W7, VK5, VU, and YS as well as many European signals sub-horizon.

Operating Notes

Do not think that you will need to use a big linear and a high gain beam for these DX contacts. The transponder is highly sensitive and has a powerful downlink as well. G4RRX/M runs a 28 MHz tuned mobile whip and 50 watts. He has a perfectly readable signal. Although a high gain elevated beam will help you for sub-horizon DX, it is not essential.

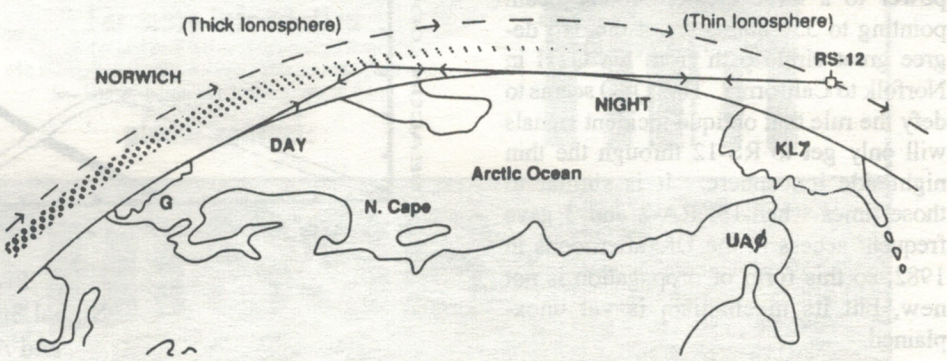
AMSAT-UK's chairman, Dr. Arthur Gee, G2UK, runs a simple 75 meter trap dipole only 10 feet off the ground, and such is his lack of low angle signal that he is inaudible on the uplink frequency although he is only twenty miles distant from G3IOR over the flat Norfolk terrain. Arthur gets not only excellent in-range results, but sub-horizon access also, as I have often heard good signals from him via RS-12 when it was well beyond his 'LOS' circle.

I use a 21/28 MHz three element beam at 65 feet or a dipole sloping at 30 degrees, or a multiband trap dipole as alternatives. All of these give good sub-horizon performance, although it has to be admitted that the signal to noise ratio is far superior on the directional antenna.

Although it is preferable to be able to monitor your own downlink by a separate receiver, it is not essential. Many users have a lone HF transceiver, and on the proviso that you can change from 21 to 29 MHz in a finite space of time, all will be well. If you have but a single transceiver, then the uplink to downlink relationship will place you well within the appropriate audio pass band to identify your own emerging frequency, as the Doppler shift is slight. The RS-12 Mode 'K' transponder input running from 21.210 to 21.25 MHz will give a 29.411 to 29.451 MHz proportional linear return (see Figure 7) with only some 0.9 kHz of combined Doppler shift. (The 10 meter beacon, which is on continuously, shifts from only 29.4086 to 29.4074 MHz during an overhead pass). If you add 8.201 MHz to your 21 MHz uplink, you have the non-Doppler shifted corrected downlink frequency upon which you will be present. When you move up by, say, 2 kHz on the 21 MHz uplink, you will also proportionately move up 2 KHz on the 29 MHz downlink. The total passband, given as 40 KHz, is in fact much wider, and can be heard over at least 70 KHz, i.e., 15 KHz either side of the stated band edge, albeit at reduced sensitivity and output efficiency. As with our HF bands and other satellites, the lower half of the transponder passband is for CW and the higher for SSB, with mixed modes in the center. When you operate, find both a clear downlink and also a clear uplink frequency, as other terrestrial users may be in the uplink passband on 21 MHz, which is not reserved for satellite use. If you are fortunate enough to have a separate receiver, adjust your transmitter to the appropriate calculated uplink for the downlink required, or vice versa and you should hear yourself.

Should you have a modern PIN diode switched transceiver with rapid QSK set up, then you may just hear the tail end of your own transponded return, as the long path will delay the return signal sufficiently for you to catch it. An alternative used by G3IOR is to build a 29/145 MHz converter, so you will be able to monitor your own downlink by using your 2 meter receiver. You may well get 21 MHz

Figure 4:
Side Path View
Sub Horizon Path



breakthrough on 29 MHz, but a simple parallel tuned circuit at 21 MHz in series with the receive antenna and/or a series tuned circuit at 21 MHz from the receive antenna to ground will cure this problem completely.

Using the ROBOT

RS-12's ROBOT is basically similar to that of the other RS series satellites. It will normally respond to your calling it an any speed between 8 and 60 wpm, provide a serialized QSO number, identify itself, and then wish you 73 before it signs off with you to call CQ again. It may well not work you if your morse CW and the dot/dash ratio are not perfect, and even perfect morse can be degraded when received multipath. If QRM is present, the ROBOT will state this. If you send too fast for it, however unlikely, it will say 'QRQ', while if you are too slow it will say 'QRS'. 'QRZ' or 'RPT' will be sent if it is not sure of your callsign. The ROBOT center calling frequency is 21.1297 +/- only 0.45 kHz shift of Doppler. As it is 3.2 kHz wide to the -3 dB points, it gives no problem of access.

Just call (for example) 'RS12 de G3IOR AR following its CQ call. You will hear yourself and hopefully the response.

Future World-Wide Oscarators

As most every HF amateur probably has already in his shack or outside it the complete and effective capability, equipment and antennas needed for mode 'K', it provides an excellent low cost introduction to satellite operations, essential for many of the rarer parts of the world which may not have the incentive, financial means, technology, or even the band availability to be able to activate the 'B', 'L', or 'S' modes. Future AMSAT support and needed new blood may stem from such HF low cost beginnings.

RS-12 on 'K' mode has the potential to be able to work the whole world, even permitting antipodal QSO's with parts of it that even our high apogee Phase II orbiters will not reach. You will find this mode to be quite fascinating, and a means of working those 21 or 28 MHz inter skip zone fellow amateurs, as it will reach to areas that other propagators will not. RS-12 is very user-friendly, and it recommended to HF DX operators, newcomers, those who have 'done it all', educators, experimenters, propagationists, plus old and new satellite fans alike.

When the autumn equinox is on the decline, by the end of September, the 'long path' via RS-12 mode 'K' should be open again, until late January at least.

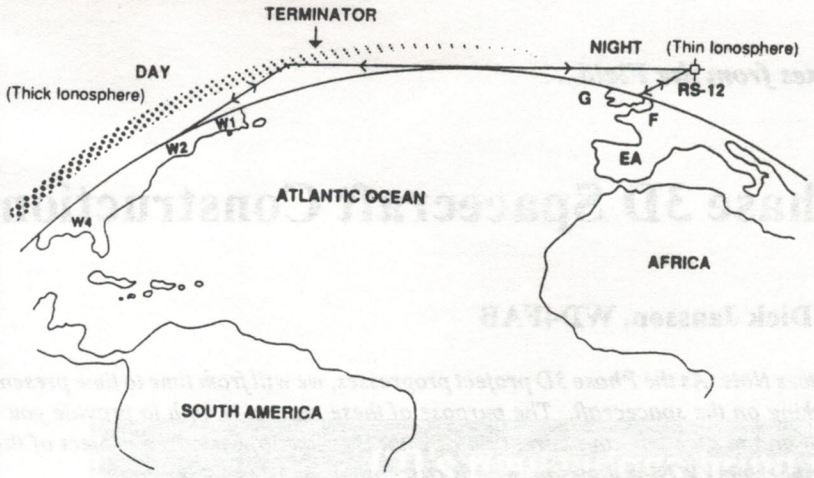


Figure 5:
Side Path View
East Coast to UK

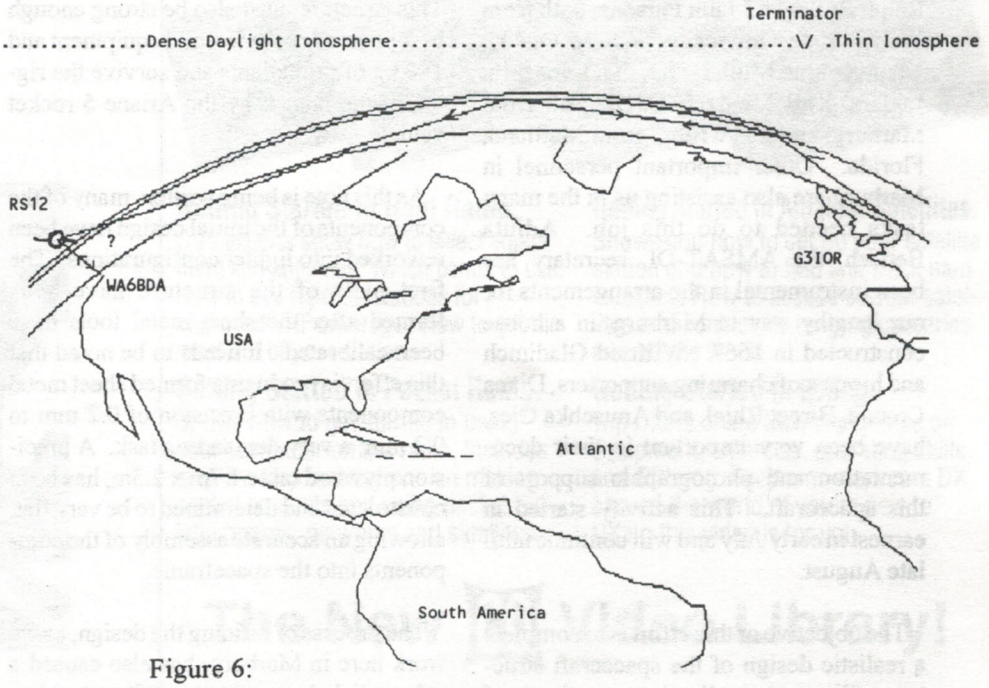


Figure 6:
Side Path View
West Coast to UK

Figure 7
RS-12 Mode K Frequencies (Measured)

Beacon / Robot	29.408 MHz (CW)
Beacon / Robot	29.454 MHz (CW)
Mode K Uplink	21.210 - 21.250 MHz (SSB,CW)
Mode K Downlink	29.411 - 29.451 MHz (SSB,CW)
ROBOT K Uplink	21.130 MHz (CW)
ROBOT K Downlink	29.408 or 29.454 MHz (CW)

Notes from the Field...

Phase 3D Spacecraft Construction Activities

by Dick Jansson, WD4FAB

Editors Note: As the Phase 3D project progresses, we will from time to time present field reports from correspondents who are actually working on the spacecraft. The purpose of these reports is both to provide you with information about the progress of the project itself and to give you an impression of what it is like to work on a project of this magnitude. Our first report comes from AMSAT Engineering VP Dick Jansson, who is currently in Marburg, Germany.

A team of constructors has been formed in Marburg, FRG, to fabricate the initial Engineering Model of the International Phase 3D spacecraft. This group includes Ralph Butler and Jaim Parsons, both from Weber State University (WSU), Ogden, Utah, Konrad Müller, DG7FDQ, Joachim Lüders, Karl Meinzer, DJ4ZC, all from Marburg, and this writer, from Maitland, Florida. Other important personnel in Marburg are also assisting us in the many tasks needed to do this job. Adjuta Bertsch, the AMSAT-DL secretary has been instrumental in the arrangements for our lengthy stay in Marburg, in a house constructed in 1667. Wilfried Gladimch and his cast of charming supporters, Diana Cronau, Birget Rhiel, and Anuschka Gies, have been very important in their documentation and photographic support of this spacecraft. This activity started in earnest in early July and will continue until late August.

The objective of this effort is to complete a realistic design of the spacecraft structure utilizing the collective experience of this international group. Another important aspect of this effort is to be able to employ the expertise of Konrad Müller, of AMSAT-DL, and to translate that capability into terms that can be used by the AMSAT-NA group from WSU. Konrad has been one of the key members of the previous Phase 3 spacecraft construction programs.

We are working against some serious mass problems caused by the size of the structure and launch vehicle limitations. The complete spacecraft with its electronic and other equipment, must have a 'dry' mass (without propellants) no greater than 216 kg. The spaceframe must be as light as possible and we are targeting that to be no more than 50 kg. (The Phase 3C, OSCAR-13, spaceframe was 7 kg.) This structure must also be strong enough to support all of the internal equipment and 180 kg of propellants and survive the rigors of the launch by the Ariane 5 rocket vehicle.

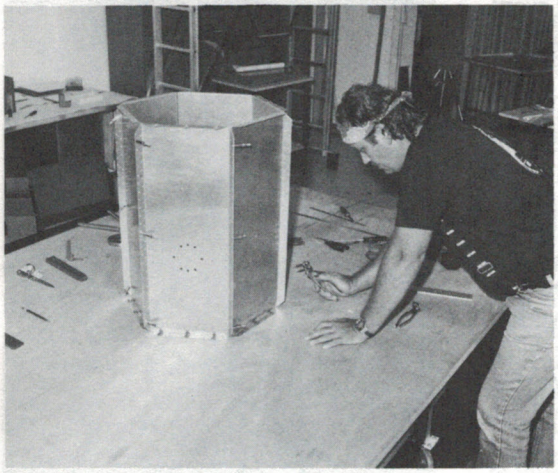
As this note is being written, many of the components of the initial design have been reworked into lighter configurations. The first parts of the structure have been formed after the sheet metal tools have been calibrated. It needs to be noted that this effort is producing formed sheet metal components with precision of 0.2 mm to 0.3 mm; a very demanding task. A precision plywood table 1.7m x 2.5m, has been constructed and determined to be very flat, allowing an accurate assembly of the components into the spaceframe.

The process of refining the design, as we work here in Marburg, has also caused a substantial documentation effort to keep the spacecraft drawings up to date so that the team has the latest information to use. This ongoing design effort is being done on a light-weight (2kg) notebook computer, at all hours of the day and evening, using AUTOCAD as the graphical tool. It is essential that we keep track of the design being constructed so that we can duplicate this effort and build the Flight Model spacecraft later in 1993. The international documentation of this project has been an ongoing effort between Wilfried Gladisch and this writer. Wilfried is a superb graphic artist and has provided massive volumes documenting the Phase 3 spacecraft. A number of photographs that illustrate this current effort have been provided by Wilfried.

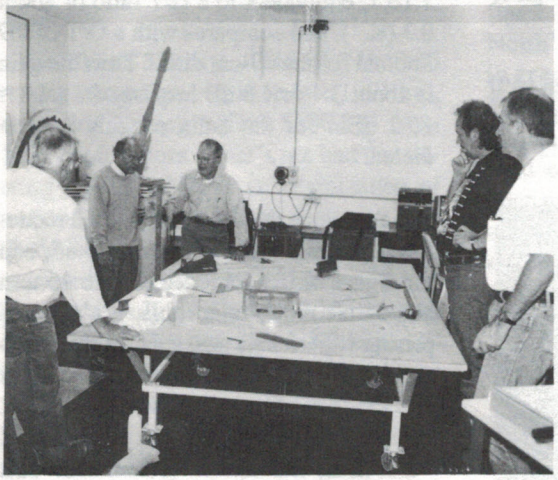
The Utah team has done a stupendous job to get ready for this effort. Their efforts provided the key machined parts needed to form the six corners of this hexagonal structure Three of these Corner Posts are used to attach the entire spacecraft to the Ariane 5 launch vehicle. A number of essential and very large drill jigs have been machined by this group to precisely locate the many thousands of screw and rivet holes needed in the panels of the structure. Even as the construction team is working in Marburg, there are a number of others still supporting the effort at WSU, getting ready for the construction of the Flight Model spacecraft.

When the US group arrived in Germany, our suitcases were loaded beyond belief with many pieces of hardware and many tens of thousands of screws and rivets needed for this effort. In addition the Utah group brought along all of the components needed for the cases for the spacecraft Electronic Module. For these assemblies, hundreds of interchangeable parts were machined by the students at WSU in the past year. Their work will now allow the European electronic constructors to complete their modules for integration into the flight spacecraft.

When we have completed our efforts in Marburg, we will have a clear definition of the Flight Model of spaceframe for Phase 3D to construct at Weber State University, starting in September, 1993.



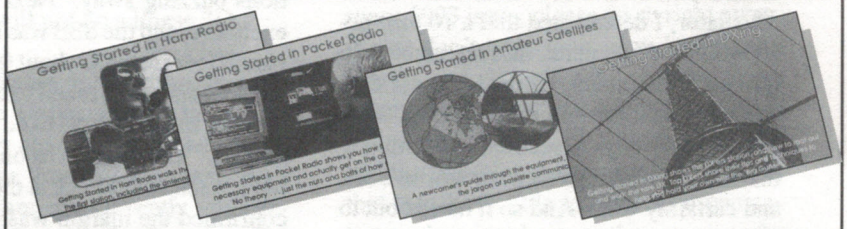
Jaim Parsons checks the assembly of the Central Cylinder for the spacecraft.



The principals of the construction team are assembled to examine the dimensional accuracy of a pre-bent heat pipe unit (shown on the table). From left to right: Konrad Müller, DB7FDQ Karl Meinzer, DJ4ZC, Dick Jansson, WD4FAB, Jaim Parsons and Ralph Butler.

The Authority on Amateur Radio CQ

CQ's new videos bring the exciting world of amateur radio into your living room!



Getting Started in Ham Radio.
CQ's experts show how to select equipment and antennas. Which bands to use. How to use repeater stations for improved VHF coverage. How to get the most out of your station.

Getting Started in Packet Radio.
Shows how to get started in using your computer on the radio. Includes step-by-step instructions on making packet contacts and using packet bulletin boards, networks and satellites.

Getting Started in Amateur Satellites.
Shows you how to set up your satellite station and how to find and track ham satellites. How to access current satellites and contact far ranging countries around the world.

Getting Started in DXing.
Top DXers share their experience on equipment, antennas, operating skills and QSL-ing. See hams work rare DX around the world. If you're new to DXing this video is for you.

The New CQ Video Library!

Now, for the first time, CQ brings you all our experience on video tape. These videos will help you get started and improve your existing skills in amateur radio.

Only $19.95 each!

Whether you're a new ham or just getting started in Packet, Satellite or DXing we've got your video. Each tape gives you first-hand tips from hams who are on the air. They take you under their wing and show you just what it takes to get the most out of our hobby!

They're only $19.95 each (plus shipping and handling).

Available at your local dealer or order from CQ directly (516) 681-2922

CQ Communications, Inc. 76 North Broadway, Hicksville, NY 11801
Fax (516) 681-2926

Small iS beSteSt

by James Miller, G3RUH

Readers will be familiar with my recent advocacy of a 60-cm dish for Oscar-13 mode-S reception. Since "mine" is frequently down for demos, photos, talks etc, I decided to make another antenna for permanent installation. My goal was "the smallest possible antenna that will let me decode the PSK telemetry beacon error free at apogee with a low noise (0.6dB) pre-amp".

Having measured the beacon SNR at apogee on a 60-cm dish, I knew how much I could afford to throw away with a smaller antenna, so after a few momemts with a calculator, I determined that a 16 turn helix would be adequate. In fact, since a 16 turn helix has about 4.5 dB less gain than a 60-cm dish, but the dish is about 3 dB overkill anyway, it seemed not unlikely that the little antenna would work on SSB, and certainly CW. And so it turned out to be.

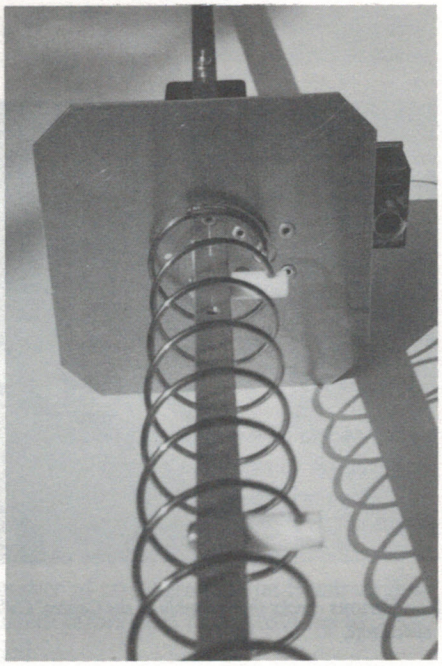
One Saturday afternoon, I got out my techie's armoury; ruler, hacksaw, file, scissors, hand drill etc and built a 16 turn S-band helix.

Construction is exactly the same as per my dish article in the *Amsat Journal*, except there are more turns, and of course it is right handed. They are supported every 5th turn (starting at turn 3/4) with three PTFE spacers screwed to the boom and drilled through for the helix. The matching strip spacing is slightly increased; 2 mm at the start, 8 mm at the end.

I fixed a camera adaptor to the boom, clipped the antenna to my tripod and set up shop on the balcony. Next I coupled on the low-noise pre-amp and converter, wired to an FT290R on the balcony and a FT736R in the shack, aimed vaguely in the right direction and waited for mode-S.

Testing a new antenna the first time is always exciting. Mode BS was on, and instantly there were the usual mode-B stations buzzing away. Next came mode-S exclusive, and the SSB was loud and clear! Noisefloor increase about 0.3 dB. Finally the acid test, the beacon exclusive. I went into the shack and checked the telemetry. Perfect. The range was only 30,000 km, but a quick SNR check at the PSK decoder confirmed the margin was just enough to cover apogee too.

Next day I went out into the garden well clear of buildings, trees etc and measured the Sun noise power increase. This was



16 turn Helix Antenna for 2.4 GHz by G3RUH. Gain 15.5 dBic, RHCP. The boom is 1/2" square aluminum tube, helix 1/8" copper wire (coax inner), and the spacers are PTFE (Teflon) drilled, tapped and screwed to boom. The reflector is 5"x5" affixed by angle brackets. Matching to 50 ohm N-connector is by a brass strip fixed to first 1/4 turn (see text).

1.16:1, equivalent to a G/T ratio of about 0.3 (K^{-1}), and compares with a G/T of 0.9 I obtain for the 60-cm dish. Thus the gain is about 3:1 or 4.8 dB less, say 20 - 4.8 = 15.2 dBic for the helix roughly as predicted.

In fact since the target for AO-13 mode-S reception is a system G/T of 0.45, and the figure of 0.3 achieved for the 16 turn helix isn't much under this, it's not surprising it performs passably on the transponder. I will have to wait till September 1993 to test it for real at 43,000 km.

But man, this antenna is SMALL. Just 450 mm (18") long, 40 mm (1.6") diameter, and the reflector is 125x125 mm (5"x5"). It goes easily into a small suitcase. Its capture area is only 440 cm^2, compared with 7 square metres for my KLM14-C 145 MHz system. That's 160:1 in size!

Figures 1 and 2 show two views of the antenna. The captions give further details of the construction

It's also cheap. The most expensive part is the N-type connector. The rest is basically scrap metal you can find anywhere. It could be mass produced for well under $50 sale price. Food for thought.

A complete AO-13 S-band receive system. 16 turn helix represents the smallest practical antenna for Oscar-13 mode-S. Perfect beacon reception at all times, adequate SSB reception at R=30,000 km, and just acceptable at R=43,000 km. Preamplifier (NF=0.6 db) is coupled directly to the feed point, and drives an SSB Electronic UEK13-P3C converter behind the FT290R 2m receiver on car roof. The antenna is mounted on a camera tripod, both are less than 50 cm long and entire system goes easily into a small suitcase. Compare this with typical 145 MHz downlink equipment!

Apogee View:
(continued from page 3)

accounting of their incurred AMSAT-related expenses via reciepts or other documentation before AMSAT will reimburse them. These expenses include telephone charges, necessary travel, postage, materials and the like.

Now, for how much AMSAT-NA is "worth". Currently, our assets, including the money raised for Phase 3D, stand at approximately $400,000. About $160,000 of this is represented by the market value of common stocks (mostly the "Baby Bells") and mutual funds. However, the best way to get a complete picture of the overall financial condition of AMSAT-NA, is to study our annual audited financial statement. The 1992 audit is available to any member for the asking. Those in the U.S. may send a 9 x 12 inch envelope with $.75 postage to our office at 850 Sligo Ave. Suite 600 Silver Spring, MD 20910. Those outside of this country, should provide sufficient funds to mail 4 ounces back. Please be sure to include your membership number with your request.

For Phase 3D, the AMSAT-NA fund raising campaign begun in late 1991 has, as of this writing, raised $180,541 from 1484 contributors. That's not bad considering AMSAT-NA is an orginization of just under 7,000 members. However, it is obviously far short of the $1.5 million expected from our part of the world. In fact, it's only just over 10% of that amount. So far, our Phase 3D expenditures have amounted to $79,626, almost $20,000 of which went for material that had to be scrapped following the ESA-mandated change to the launch vehicle interface. Part of this includes $15,800 for inert heat pipes for use in the Engineering Model being built in Germany this summer. It also includes $9,500 to reimburse Weber State University for work in fabricating hardware for the Engineering Model. As you can see, the Weber State effort is not free, but it is very cost-effective compared with having similar work done at a commercial precision machine shop. It also has the advantage of involving students in a "real world" project, which is consistent with one of AMSAT's major objectives; promoting education. The rest has been expended for necessary services such as telephone, telex and transportation, all directly related to the task of designing and building the Phase 3D satellite.

Unfortunately, we're facing some additional, immediate and rather "hefty" expenses for our share of the Phase 3D effort. For example, we will very soon need to send a $25,000 down payment along with our order for solar arrays. The total cost for these arrays are estimated to be around $150,000. The remainder will be due and payable upon delivery of the completed arrays next year. These expenses are clearly in AMSAT-NA's "court", to pay as they're an integral part of our overall responsibility to provide the spacecraft's structure. We have also already incurred expenses associated with transporting and housing several people, including Dick Jansson and two Weber State people, in Germany while working on the Engineering Model of Phase 3D this summer. Obviously, we must find some new money soon or there will not be a Phase 3D.

The ARRL Phase 3D fundraising campaign, now underway, should be a great help. But there are other expenses, in addition to those immediate ones noted above, which are not currently well defined. One of these is the launch. The North American share of that important ingredient could run as high as $1,000,000! Batteries are another unknown. If we have to purchase flight qualified cells at the "regular" price on the open market, the tab could also run as high as $1,000,000. Naturally, we are trying to avoid such a situation.

It's important to remember that in our 1992 audit, the figures are "as of" December 31, 1992 and that they DO include funds raised for Phase 3D. When put in that context, especially in light of the significant expenditures for Phase 3-D which will be needed for 1993 and beyond, you can see that AMSAT-NA is NOT rich. We are solvent, but not rich. As always, we need all the assistance we can get, in terms of both monetary contributions and volunteer help.

AMSAT-NA is not a wealthy organization with a large, highly paid staff and plush offices. I believe that this shows that your dues and contributions do not go to pay for such extravagances. Rather, they support the publication of this Journal, some of our education efforts, satellite construction and operation expenses, overhead costs, such as office rent (less than $900 per month); as well as Martha's salary and that of our part time typist. General contributions go toward improving the long-term viability of the organization. Contributions earmarked for Phase 3D go ONLY toward supporting the design and construction of that spacecraft. Furthermore, funds for promotion of the Phase 3D fundraising campaign are supplied from AMSAT-NA resources - not from money raised for Phase 3D.

Clearly, AMSAT-NA is a volunteer organization and more volunteer help is always needed. If you can offer assistance in anything from manning AMSAT booths at hamfests to RF and digital design, fundraising, law or accounting, please get in touch with Martha. She'll steer you to the right person. Also, if you didn't fill out and return the Skills Inventory, which appeared in the January/February 1993 issue, please do so right away. If you don't have your copy handy, call Martha and she will send you the Skills Inventory form for you to complete.

Unfortunately, many people still think that they have little to offer an organization such as ours becuase they aren't technically inclined. Believe me, the hands-on technical work, while a critical part of what we do, makes up only a small part of the total volunteer effort that AMSAT needs if it is to serve it's members effectively as well as build and launch the most complex and expensive satellite in our history.

In his editorial appeal for Phase 3D funds in the August, 1993 Edition of QST, David Summner, K1ZZ, got to the very heart of the matter this way: "AMSAT", he wrote, "has an extraordinary record of accomplishment over its 25-year history. Rarely has a group of volunteers managed to do so much with so little."

I trust we will continue to do so....but only with YOUR help!

Call for Articles:

The AMSAT Journal is a compilation of material submitted by AMSAT Members. *The AMSAT Journal* is always looking for new material. If you have a project you have been working on - let us know about it. Just as you have benefited from the the experiences of others, let others benefit from your experiences. Look on Page 3 for details describing how to submit material to the Editorial Office.■

AMSAT-NA Activities Update

Minutes of the May 22-23 Board of Dirctors Meeting
Transcribed by Bill Hook, W3QBC

Editor's Note: While this article provides a peek inside the recent Board of Director's Meeting, it is really much more than that. It provides a status report on virtually all of AMSAT-NA's activities and also provides considerable information about the activities of other AMSATs world-wide.

The meeting was held at the AMSAT office. Board members in attendance at various times were Bill Tynan W3XO, Jan King W3GEY, Dick Daniels W4PUJ, Joe Kasser G3ZCZ, Andy MacAllister WA5ZIB. Others participating were Martha Saragovitz Corporate Secretary, Ray Soifer W2RS ExecVP, Dick Jansson WD4FAB VP Engineering, Frank Bauer KA3HDO VP Manned Space Programs, Bob Carpenter W3OTC, Keith Baker KB1SF, Dan Schultz N8FGV, Dino Lorenzini KC4YMG, and Mark Kanawati N4TPD.

I. Report on Dayton Hanvention

Martha Saragovitz led off the report of our participation at the 1993 Hamvention. Funds collected exceeded those of any previous year with gross donations of $19,572. Volunteer help at the booth was exceptional both in quality and quantity. Ninety new regular AMSAT members, plus one life member were enrolled and 95 renewals were received. Various trinkets, software and books, including Keith Baker's How to Get Started on the Amateur Radio Satellites were well received. A $900 cash donation, plus one complimentary booth space were provided by the Dayton Amateur Radio Association. Other cash contributions amounted to $500. As of the meeting, expenses amounted to somewhat over $4000.

Additional expenses are expected to be about $1500. So AMSAT's participation at Hamvention is expected to net over $14,000. The Board expressed thanks to all of those whose efforts produced the substantial financial input for the organization as well as enhancing its image among members and Hamvention attendees in general.

Our participation in Dayton was particularly notable this year as Dick Jansson was the recipient of the Technical Excellence Award. This was presented at the Saturday evening banquet and Dick was able to get in some good plugs, for the Amateur space program in general, and Phase 3D in particular. Other noteworthy events at Dayton included two well attended AMSAT forums. One presentation was given by Frank Bauer highlighting our recent SAREX activity. This was followed by a brief introduction to getting started on the satellites by Keith Baker. The other forum was lead off by Dick Jansson describing progress on the Phase 3D spacecraft.

The Hamvention also featured talks by Keith Pugh W5IU and Ed Krome KA9LNV. In addition to the booth activity and forums, several valuable contacts with industry representatives were made, as well as several individuals who may be of assistance in Phase 3D. Bill Tynan, Dick Jansson and Kieth Baker attended the Thursday evening Industry Meeting. A chance meeting with two Microsoft employees yielded donations of 3 copies of their Project software which is being used to schedule Phase 3D. The possibility of developing Windows-based software for satellite tracking was also discussed with them. Rod Blocksome KØDAS donated a large volume of circuit board material, which has excellent heat sinking capabilities and is suitable for microstrip construction. These board may have application in Phase 3D electronic modules.

Other Hamvention contacts included repesentatives from Ten-Tec Inc. who have expressed interest in producing equipment suitable for satellite operation, and wanted our suggestions.

With regard to the amateur radio industry, Jan King pointed out that AMSAT is building a spacecraft, which if it were done by commercial organizations or government, would be valued at perhaps $50 million for construction, and another $30-50 million for the launch. He contended that our friends in industry should contribute at least as much as our members are doing. (See Section XII.) The concept of selling "access codes" to those wanting to use our satellites was suggested and quickly dismissed as inappropriate to the spirit of amateur radio and our goals.

II. Technology Reinvestment Project

Jan King described a new federal program, coordinated by ARPA, that is intended to support socially relevant issues by funding the transfer of Government-developed technology to industry, and vice versa. They are requesting proposals that include, among other things, benefits to education. Instructions for submitting proposals are to be found in a Program Instruction Package available from ARPA. He suggested that, by teaming with an educational institution to submit a joint proposal of exceptional merit it may be possible to obtain federal funding for AMSAT educational programs. The high-orbit GPS work being done by AMSAT was suggested as another area where our technology might be considered unique and valuable. It was decided that we will

attempt to obtain the appropriate PIP from ARPA and then consider future action.

II. AMSAT Annual Meeting

Plans for the 1993 Annual Meeting and Space Symposium to be held October 8, 9, and 10 in Arlington, Texas have been summarized in a written report by Keith Pugh W5IU as follows: Preparations are proceeding satisfactorily in most areas. The call for papers has just begun and will be announced on the ANS this week. A quest for door prizes will begin soon. Martha Saragovitz will provide a list of last year's donors. Committee chairman have been appointed and most have already begun to function. A tour of surplus outlets in the Dallas Fort Worth area will be conducted on Thursday and an antenna range will be in operation. during the Symposium. Local clubs have begun to provide volunteer support. Regularly scheduled planning meetings will begin in June.

Al Brinkerhoff WB5PMR has volunteered to organize and manage the 1994 meeting in Orlando, Florida.

III. Operating Satellite Report

The following spacecraft conditions were reported:

1) On AO-13, the Mode L transmitter apparently has stopped working requiring the deletion of Modes J and L from the schedule.

2) AO-16 is working properly, however it seems to have reversed its spin. It was speculated that this may have been caused by a loss of paint on one side of the antennas.

3) LO-19 has had new software loaded and is performing satisfactorily.

4) The 2-meter transmitter on ARSENE has extremely low output with a warbling carrier. Only Mode S is working properly at present. It's anticipated that Project OSCAR will soon designate this satellite as ARSENE-OSCAR-24. (See Item VI.)

5) A high level of terrestrial activity is desensitizing RS-10 so that its very difficult to hear the robot signal. It is reported that there have been problems with the satellite changing modes unexpectedly requiring special command techniques.

Jan King suggested that we ask Harold Price if AO-16 can be set to 4800 baud one day a week, e.g., on Wednesdays. The question of running AO-16 with a 9600 baud downlink was also raised and referred to Keith Pugh as V.P., Operations.

IV. Publications Report

An advertising manager for the Journal is being sought. Bill Tynan is doing the follow-up using the Skills Inventory responses received so far. Larry Brown NW7N has suggested the publication of an anthology of AMSAT articles. Dick Jansson will outline the topics to be covered and submit the manuscript to the ARRL after Bill Hook W3QBC has reviewed AMSAT publications to find suitable material.

V. Issuance of OSCAR Numbers

A decision was made at the October 1992 Board meeting that Project OSCAR should be asked to assume the responsibility for issuance of OSCAR numbers to new spacecraft meeting the criteria to qualify as Amateur Radio Satellites. This suggestion was transmitted to them and it is understood was acted on favorably by the Project OSCAR Board. Nick Marshall W6OLO is the new President of Project OSCAR and Bill Tynan met with him at Dayton on this and other matters. Ray Soifer was asked to visit with the Project OSCAR members during his forthcoming trip to San Francisco, including Nick, Ross Forbes WB6GFJ and possibly Lance Ginner K6GSJ. Ray was asked to get their opinion as to ARSENE becoming an OSCAR.

VI. Licensing of Microsat Technology

Dino Lorenzini presented a report of Interferometrics' attempts to market Microsat technology under terms of an agreement they concluded with AMSAT-NA four years ago. He said that numerous attempts have been made to find a buyer for a commercial satellite for a near-term launch opportunity. All of these attempts have been unsuccessful so far, but they do not want to forego the launch opportunity. Therefore, in cooperation with AMRAD (Amateur Radio Research and Development), a technically oriented amateur radio club in the Washington, DC area, they are including an amateur package, along with the commercial equipment, in their spacecraft. The amateur package will be a 9600 baud packet system, possibly with an experimental 19.2 k baud downlink. AMSAT was asked to assist in the preparation of FCC documentation for the licensing of this satellite. It was agreed that we will render such assistance, provided that we determine that AMRAD/Interferometrics effort represents a true Amateur Radio satellite. (This has since been so determined and AMSAT did participate in preparation of the initial FCC filing.)

Dino also said that they have been cooperating with AMSAT- Italy in the construction of their "IT-Sat". He added that it will undergo vibration and thermal-vacuum testing along with the Interferometrics satellite in June. The two are scheduled for the same launch on the Ariane Spot-3 Mission currently slated for August 31, 1993.

Dino then proposed a change in the terms of the agreement between AMSAT and Interferometrics, in which AMSAT would recover a straight 14% of the value of each commercial satellite launched. This value would be assumed to be $300,000 (adjusted for inflation). This would replace the rather complex schedule of fees in the current agreement. He justified the proposed change by noting that one of the problems with the current agreement is that customers do not want to buy mere satellites. Instead they seem to more apt to contract for complete packages of services; including frequency selection, licensing, construction, checkout, launch, insurance, operations and even ground station terminals. Alterna-

tively, they may opt merely for communications services on already launched spacecraft.

VII. Other Amateur Satellite Projects

UNAMSAT

David Liberman XE1TU sent a status report on progress being made on UNAMSAT-1 at the Universidad National Autonoma (UNAM) in Mexico. Their spacecraft is now in the final assembly phase, but there are some problems yet to be solved. A scheme to constrain the antennas prior to separation from the rocket had to be developed rather late in the program. The solution selected calls for the antennas to be rolled around the satellite's body and strapped to it with polyethylene cord. A circuit has been added to sense separation, wait for three minutes, and then send one Ampere of current through a nichrome wire to burn the polyethylene and release the antennas. If this fails, solar UV is expected to eventually perform this function. Also solved is the problem of an appropriate power supply for the pulse transmitter. In previous designs, the 70 watts peak drawn from the power buss, caused unacceptable voltage drops. The new supply gets around this with a system using 18 capacitors charged in parallel and discharged in a series-parallel arrangement. This supply has now been built and tested and works well. There has been a new delay in the launch date to July 26 with a possible extension of one or two weeks.

SEDSAT

Dick Daniels was asked to learn if SEDSAT has a launch date scheduled and to verify its likely altitude and inclination. This information was particularly sought by Ron Broadbent of AMSAT-UK.

SPARTAN

Dan Schultz described this NASA project that has offered a slot for an amateur radio package on a March, 1995 Shuttle Mission. Three scientific payloads are to be deployed and re trieved a few days later. They are designed to collect scientific data that will be recorded on-board. without the use of radio uplinks or downlinks. Some NASA investigators have suggested that the quality of the experiments might be enhanced by including a radio transmitter/receiver package that would be capable of, not only amateur radio experimentation, but also have the capability of exerting a limited amount command and data collection capability in support of the scientific mission. Jan King suggested that since the flight will be of short duration, an ATV camera might be employed as has been done on some amateur balloon flights.

Ray Soifer noted that this project does not appear to him to be a bona fide Amateur Radio application, although it might be possible to obtain an STA from the FCC to cover it. He added that, in his opinion, this would represent a poor precedent. Bill Tynan cautioned that AMSAT's resources are dedicated to completing Phase 3D and that the time and effort required to prepare equipment for such a mission as SPARTAN might negatively impact our Phase 3D participation. It was noted, however, that the mission might provide an opportunity to flight test some of the GPS hardware planned for Phase 3D. Frank Bauer noted that SPARTAN might also provide an opportunity to test the flightworthiness of specific antenna structures which might be proposed for future SAREX missions. Action on participation in SPARTAN was deferred to a later meeting.

VIII. FCC Briefing

Paul Rinaldo W4RI of ARRL has advised us that the League will present a 10 to 20 min technology briefing to the FCC near the end of June and would like to include an update on what the amateur community is doing in space communications. It could include a briefing on Phase 3D plus all that is new since the Microsat launch, e.g., what UO-22 and KO-23 do and how they are being used. I was agreed that we should assist and participate in that briefing. (Dick Daniels presented the briefing.)

IX. Household Memberships

A motion was made, seconded, discussed and amended to read as follows: "Whenever a household has one full member, additional persons residing in that household may join AMSAT, without receiving the AMSAT Journal, at the current rate paid by the full member less the amount allocated for the Journal, and each of these persons is entitled to a vote". Thus, the current dues rate for Household Members will be $15.00 domestic and $30.00 foreign. Five BoD votes were in favor (plus Tom Clark's, by telephone) and none were opposed.

X. CCIR and NTIA Activities

Perry Klein W3PK submitted a written report on our participation in CCIR and NTIA activities. A CCIR study section and four recommendations on the Amateur and Amateur Satellite Services were approved at a recent Working Party 8A meeting in Tokyo, and are now working their way through the approval process. The past several meetings of the Washington group have discussed the desirability of putting together a CCIR handbook on amateur radio and amateur satellites. It was noted that the CCIR "Green Books" will no longer be distributed and thus the CCIR handbook will be the only vehicle for exposing frequency regulators to the Amateur Service and the Amateur Satellite Service.

AMSAT responded to the NTIA's request last fall in which NTIA asked for comments on current and future frequency requirements. The NTIA held a "Strategic Spectrum Planning Seminar" in Washington on March 3, 1993 in which they summarized the filings received. While many of the filings were general, stating few specific requirements, AMSAT's and ARRL's filings did, and these filings were presented by NTIA people in considerable detail, complete with viewgraphs, outlining the specific requests made. AMSAT's filing included requests for amateur satellite allocations at 29.7 to 30 MHz for downlink use, an allocation in the 50 MHz band, and extension of the 3400-3410

MHz amateur satellite band to worldwide use (it's currently not available in Region 1). We also stressed the desirability of upgrading small band segments to primary status and suggested specific frequencies for such segments.

XI. Phase 3D

Dick Jansson reported on the Phase 3D planning meeting held recently in Munich, Germany. This was announced as an all-Europe meeting primarily aimed at initiating the design and construction of specific electronic modules, and further discus the specifications for the spacecraft's local area network (LAN). In addition, because Tom Clark was in Europe, the agenda included the spacecraft central clock and GPS utilization/implementation. However, one of the things coming out of the meeting was a list of Phase 3D frequencies, which made no mention of a 2 meter downlink. Dick emphasized that this was only because no one present at that particular meeting had volunteered to build a 2 meter transmitter. He stressed, and the Board members present agreed, that the list of frequencies arising from the meeting did not represent a change in the planned band coverage for the satellite. Howver, everyone concured that a builder for a 2 meter transmitter must be found soon, if there is to be a 2 meter downlink [see annoucement, this issue -ed].

Dick also reported that good progress is being made with antennas. The 10- meter design is essentially a 2 element beam with approximately 4 dBic gain. The 2-meter design consists of three folded dipoles standing off the surface of the satellite. It is estimated to provide a gain of about 11dBic. For the 70-cm (U Band), a 6-element patch array surrounding the motor nozzle, has been chosen. Its gain is estimated at approximately 15 dBic. The L and S Band antennas are expected to employ simple parabolic dishes, with gains in the order of 20 dBic.

Dick also said that ESA has indicated that it now requires that we build two SBSs (the cylindrical section that encloses our spacecraft). He noted that, if this requirement stands, it will represent a significant cost and facility burden on us.

Plans for this summer include construction of a Phase 3D engineering model. He emphasized that this must be done before attempting to build the final flight version. In support of this he has spent much time producing drawings and doing the structural FEA (finite element analysis).

With regard to the battery, a meeting with one of the experts at Wright Field provided insight into the technology needed. The most stringent requirement is the arc-jet motor, which requires one KW for up to one hour at a time. The current concept is for 22 - 35 to 45 ampere-hour nickel-hydrogen cells. Cost could run as high as $1 million if we find that we have to buy space qualified cells at the regular price. Solar cell requirements have been established. The cells will be arranged in 6 panels having 2 different configurations. The four deployed panels will contain 150 cells each while the two, body-mounted panels will use half that number with each active cell separated by a heat-compensating dummy. The cost for solar arrays has been estimated to be approximately $150,000.

Keith Baker described how Phase 3D scheduling and progress is being followed using Microsoft Project software. Gantt chart, Pert chart and task sheet formats were displayed.

Dick stressed the need this summer to build an engineering model plus some machined parts for the flight spacecraft. The engineering model will be built in Germany by one WSU student, plus Ralph Butler and Dick Jansson. Meanwhile in Utah, a student- supervisor and two other students will do machining of the flight hardware. He projected a cost of about $16.5 K to complete this work. It was agreed that the Phase 3D portion of the 1993 budget will have to be revised to reflect this increased pace. A quote of $15.3 K, in addition to the above, has been received for fabricating the engineering model heat pipes. Dick emphasized that the engineering model being built this summer may eventually also be able to serve as a backup for the flight structure. He expects to arrive in Germany in early July to begin fabrication, and will remain there for 6-8 weeks. He stated that a site near Orlando, Florida will be chosen to for the integration to begin in the summer of 1994. It was suggested that student labor from several universities at both undergraduate and graduate levels may be employed for several months at time for the final integration steps. He thought that NASA and/or state funding might be available for partial support of these students. In response to a question by Ray Soifer, the BoD was assured that the fabrication would not involve hazardous materials or environmental pollutants. Bill Tynan mentioned that later steps in the testing would involve the generation of significant RF fields and that protective measures will be necessary at that time. Dick completed his report with a mention of the volunteers that have offered to transport the spacecraft to the various testing sites across the U.S.

Dick Daniels distributed copies of his report to besummarized and printed in the Journal. John Hansen WAØPTV, with the help of Keith Baker, has volunteered to coordinate Phase 3D news for publication. (As announced elsewhere in this issue, John has now assumed the position of Journal Editor.) Meeting follow-up items included the possibility of trading the satellite interface rings, produced for the old Ariane interface, for other hardware. Karl Meinzer is investigating this. Dick Daniels stated the need to establish a policy to deal with the large expenditures for structural items that we need to buy now. Bob Carpenter submitted the following report of the Phase 3D Fundraising Campaign. "The original Phase 3D Campaign appeal was mailed to domestic members in December 1991. An overseas mailing followed about one month later. "Thank-you" letters were sent in the summer of 1992. Another general mailing went out in late 1992. Each person who has donated since after November 21, 1992 has been sent "thank-You" letters including an accounting of their donations. These donations have resulted in most of the 1993

receipts. Similar acknowledgements will be sent this summer to the earlier donors as well as reminders to those who have not yet met their pledges.

Receipts and pledges are summarized as follows:

Received to date	$175,613
Pledged for 93 - 96	$171,621
Number of participants	1,452

Bob added that the Phase 3D Fundraising Campaign database is kept in PCFile on his computer at home. At roughly weekly intervals, it is transferred to a computer at the AMSAT office. Bill Tynan is periodically sent updated disks. Domestic mailing addresses are cross-posted from the AMSAT membership data base at the time of each mailing, based on membership number. Since quite a few donations have come from non- members, their full address are kept in the PCFile database, as well as a full address for all non-U.S. donors. As soon as the AMSAT non-U.S. membership files have been converted to a dBase system, it will be possible to cross-post them in the same manner. (See Section XIII.)

Bill Tynan noted that, in addition to the money raised specifically for Phase 3D, AMSAT-NA has about $120 K in other funds that could be called upon. The expenditures predicated make it obvious that additional financial support will be needed. Bill Tynan suggested the concept of a Solar Cell Campaign wherein donors of a specific substantial large sum, e.g. $500 would receive a plaque with a diagram highlighting the location of their particular cell. In addition to AMSAT's fundraising activities, it was said that the ARRL campaign, going to all League members, would begin soon. Ray Soifer recommended that, until we learn what contributions will be received in the form of expensive hardware such as batteries, we should establish two decision points: one when we deplete the funds presently designated for Phase 3D, and the second after we've spent approximately $100 K more and face the possibility of a shutdown of all Phase 3D work. Ray pointed out that a million dollar battery cost would bankrupt the program.

Jan King said that we need to make Karl Meinzer aware of the need for advance notice of any requirement to make a launch pre-payment. It was observed that, if we provide the SBS, this should reduce that cost. Bill Tynan noted that we have raised a substantial amount of money, when it considered that it has come only from a base of only approximately 7,000 AMSAT members. He stated that this fact should be emphasized when making presentations to potential corporate/ foundation donors.

Bill Tynan also reported that we are still negotiating details of the our agreement with Weber State University, including its Appendicies. He stated that it is critical that we finalize this document soon and added that he is working hard to accomplish this. Dick Daniels will begin work on the Appendixes and send them along to Dick Jansson for completion.

XII. Membership Database Upgrade

Bob Carpenter reported that Dieter Schlieman, KX4Y, and he have been working to upgrade the AMSAT Membership Database from dBase III to dBase IV . He noted that he purchased the latter for himself and also bought and donated to the AMSAT office another copy. Dieter has converted the present, W3IWI-created, dBase III program to dBase IV. The next step is to combine the U.S and non-U.S member lists into one data base. This new database will accommodate a variety of mailing categories such as overseas air mail and overseas surface, Canadian, Mexican etc. The new data base will provide a number of advantages such as enabling cross- posting from the membership database to the Phase 3D Fundraising database. The various Phase 3D Fundraising mailings have revealed that there are a number of problems which can be more effectively corrected with the new single database.

XIII. Long Term Plans

Joe Kasser asked the Board to consider "what happens after Phase 3D?" He believes that we are too narrowly focused upon Phase 3D and that we should look beyond building Phase 3 satellites. He suggested that we maintain interest and raise funds by planning an amateur mission to Mars. He cited several experts who think that the idea is practical. He contended that the primary objective would be educational. This led to the questions of: What will it do? Will it orbit or fly-by? What will it offer to amateur radio operators? When is the right time? How will it be financed, e.g., by selling "certificates of support" rather through a membership organization like AMSAT? And finally, who will do the work?

The senior BoD members noted that AMSAT faces a severe management succession problem and that the next generation of management must soon be identified and trained. Joe Kasser agreed to assemble a group including younger people with different viewpoints, to chart where AMSAT should go after Phase 3D including serious consideration of the Mars project.

XIV. "Attaboys and "Attagirls"

First, Martha Saragovitz was thanked for her efforts in organizing the BoD meeting. Next, the entire Phase 3D Team, and especially Dick Jansson Dick Daniels, Stan Wood and Keith Baker, were applauded for their tireless efforts in support of Phase 3D. Bob Carpenter and Dieter Schlieman were thanked for their work on the membership data base; and Bob was commended for his work on the Phase 3D Fundraising data base.

AMSAT-NA MEMBERSHIP FORM

Name: _____

Call: _____

Address: _____

_____

State/Prov: _____ ZIP/PC: _____

VISA/MC #: _____

Exp. Date: _____

☐ New ☐ Renewal

Membership is $30/year U.S., $36/- Canada, $45 elsewhere, (all payments in U.S. $) which includes six issues of *The AMSAT Journal*. 50% of membership dues are directly allocated to spacecraft development. Members receive discounts on software purchased from AMSAT. Life Membership is $600.

Mail to: AMSAT
850 Sligo Avenue, Suite 600
Silver Spring, MD 20910-4703
or
FAX to: (301) 608-3410

Join AMSAT today and help keep Amateur Radio in Space.

AMSAT News

AMSAT Seeks New Area Coordinators

New Area Coordinators in all parts of the country are needed as part of an effort to dramatically increase the visibility of AMSAT's existing operations and Phase 3D developments. Area Coordinators are the essential interface between AMSAT and the majority of radio amateurs. Their activities include staffing AMSAT booths at hamfests, making club presentations, conducting local AMSAT nets, providing individual "Elmering". Their efforts are responsible for encouraging many new satellite enthusiasts and raising much of the funding required for Phase 3D. If you are interested in becoming an Area Coordinator and providing invaluable service both to AMSAT and the "Hams" in your area please contact Larry Brown, NW7N or the AMSAT office for more information.

Larry Brown, NW7N
Acting Vice President, Field Operations
Internet: nw7n@amsat.org
Compuserve: 70471,2653
Phone: (602) 886-1957 (evenings)

New Satellites to be Launched

In late August or early September the Ariane V.59 mission will be launched from Kourou, French Guyana. This mission will include seven payloads that will be launched into a sun-synchronous orbit at 800 km, including several of interest to amateurs. The satellites being launched on this mission are:

Spot 3	(earth resources observation -the primary payload)
Stella	(German geodetic survey satellite, like LAGEOS)
Healthsat-B	(A commercial payload with a UoSat bus)
Posat	(A commercial payload with a UoSat bus)
KITSAT-B	(An amateur satellite similar to KO-23)
Itamsat	(An Italian Amateur Microsat)
Eyesat-A	(A commercial satellite carrying the AMRAD-OSCAR amateur payload).

Three of these satellites are of interest to Amateurs. KITSAT-B, which belongs to the Korean Institute of Technology, will be similar to KITSAT-A (KO-23), currently in orbit. It will provide 9600 baud store and forward capability. User frequencies will be as follows:

Uplink : 145.87, 145.98 MHz
Downlink: 435.175, 436.50 MHz

Itamsat is a new Italian satellite (a joint project of AMSAT-Italy and ARI) that will offer both 1200 baud PSK and 9600 baud G3RUH compatible modes. It contains a five channel VHF receiver and two UHF transmitters. User frequencies will be as follows:

Uplink:
145.875, 145.9, 145.925, 145.95 MHz

Downlink:
435.87 MHz (primary),
435.82 Mhz (secondary)

The satellite is a 25 cm cube weighing 10 kg. Transmitter output power is variable up to 4 watts. The UHF antenna will be a 4 element canted turnstile, while the VHF receiver will use a whip.

Groundstations currently equipped to work the PSK microsats (AO-16, LO-19) and 9600 baud UoSats (UO-22, KO-23) are already equipped to use Itamsat. PB/PG will be used as the groundstation software.

Eyesat-A is a commercial microsat that also carries an amateur payload on behalf of AMRAD (Amateur Radio Research and Development, a technically-oriented club in the Washington, D.C. area). This satellite will be capable of 1200 baud AFSK, up to 9600 baud FSK and will also have a "bent pipe" analog FM transponder mode. Amateur user frequencies will be as follows:

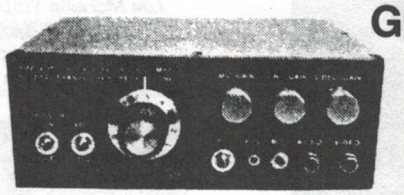
Uplink: 145.850 MHz
Downlink: 436.800 MHz

This satellite is designed for experimentation in new modulation and communications protocols and is not planned at present for routine communications services. The hardware necessary to use the 1200 baud AFSK link will simply be any standard 1200 baud TNC that has a KISS mode. The usual G3RUH compatible 9600 baud modems will be able to use its 9600 baud FSK mode. The groundstation software necessary has yet to be determined, but will not be the standard Pacsat PB/PG programs.

AO-13 70 cm Transmitter Quits

Due to the failure of the 70 cm transmitter on AO-13, modes J and L have been deleted from the operating schedule. This has resulted in major revisions in the operating schedule for AO-13. The new schedule is shown in the accompanying table.

AMATEUR TELEVISION



GET THE ATV BUG

***New* 10 Watt Transceiver**
Only $499

Made in USA. Value + Quality for over 25 years in ATV. . .W6ORG

Snow free line of sight DX is 90 miles - assuming 14dBd antennas at both ends. 10 Watts in this one box may be all you need for local simplex or repeater ATV. Use any home TV camera or camcorder by plugging the composite video and audio into the front phono jacks. Add 70cm antenna, coax, 13.8 Vdc @ 3 Amps, TV set and you're on the air - it's that easy!

TC70-10 has adjustible >10 Watt p.e.p. with on xtal on 439.25, 434.0 or 426.25 MHz and properly matches RF Concepts 4-1110 or Mirage D1010N-ATV for 100 Watts. Hot GaAsfet downconverter varicap tunes whole 420-450 MHz band to your TV ch3. 7.5×7.5×2.7" aluminum box.

Transmitters sold only to licensed amateurs, for legal purposes, verified in the latest Callbook or send copy of new license.

Call or write now for our complete ATV catalog including downconverters, transmitters, linear amps, and antennas for the 400, 900, and 1200 MHz bands.

Tom (W6ORG)
Maryann (WB6YSS)
VISA, MC, COD

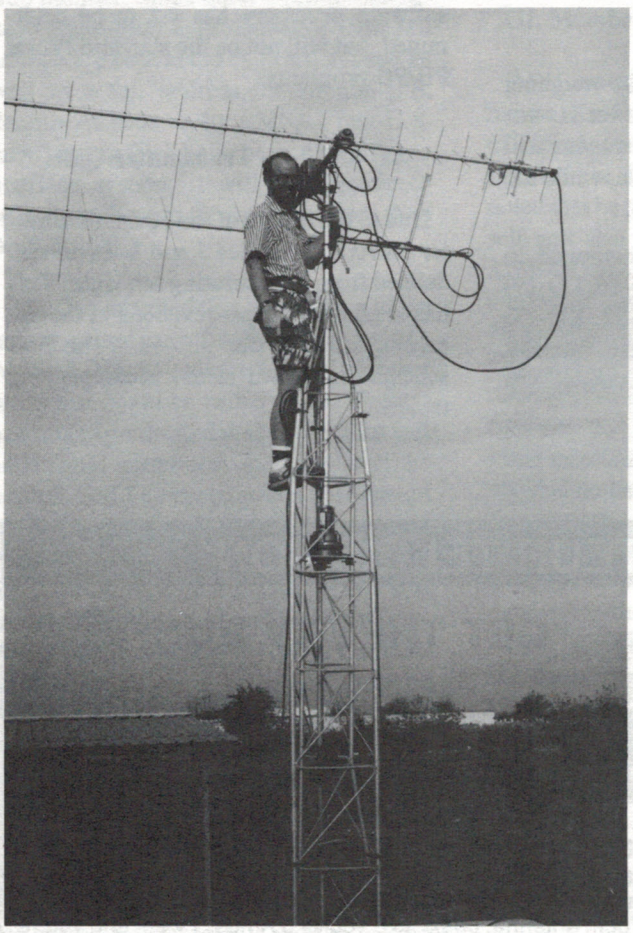
P.C. ELECTRONICS
2522 Paxson Lane, Arcadia, CA 91007

(818) 447-4565
M-F 8am-5:30pm pst.

AO-13 Provisional Attitude Schedule 1993-1994

Date	Alon	Alat	SA	to SA	Weeks
1993 Aug 23	180	0	35	-33	9
1993 Oct 25	210	0	-14	-36	3
1993 Nov 15	240	-5	-13	-35	11
1994 Jan 31	180	0	-36	36	9
1994 Apr 04	210	0	19	38	3
1994 Apr 25	230	0	21	33	11
1994 Jul 11	180	0	36	-41	10
1994 Sep 19	210	0	-25	-37	2
1994 Oct 03	230	0	-20	-28	10
1994 Dec 12	180	0	-41	---	---

Notes:
81% Moon Eclipse Nov 13, 1993
Up to 137 minute eclipses, MA 110-144 Dec 07 - Dec 23, 1993
Up to 134 minute eclipses, MA 96-108 Oct 22 - Nov 06, 1994



AMSAT Globetrotter Eric Rosenberg, WD3Q (J20BY), activates yet another DXCC country - Djibouti.

AO-13 Provisional Mode Schedules 1993

1993 Aug 09-Oct 25

Mode-B	: MA 0 to MA 60	
Mode-BS	: MA 60 to MA 120	
Mode-S	: MA 120 to MA 145	S transponder; B trsp. is OFF
Mode-S	: MA 145 to MA 150	S beacon only
Mode-BS	: MA 150 to MA 210	Alon/Alat 180/0
Mode-B	: MA 210 to MA 256	
Omnis	: MA 230 to MA 40	Move to attitude 210/0, Oct 25

1993 Oct 25-Nov 15

Mode-B	: MA 0 to MA 130	
Mode-BS	: MA 130 to MA 180	
Mode-S	: MA 180 to MA 205	S transponder; B trsp. is OFF
Mode-S	: MA 205 to MA 210	S beacon only
Mode-BS	: MA 210 to MA 226	Alon/Alat 210/0
Omnis	: MA 240 to MA 80	Move to attitude 240/0, Nov 15

Please don't uplink to B, MA 180-205. Interferes with mode S.

1993 Nov 15-Jan 31

Mode-B	: MA 0 to MA 220	
Mode-S	: MA 220 to MA 230	S transponder; B trsp. is OFF
Mode-BS	: MA 230 to MA 226	Alon/Alat 240/0
Omnis	MA 250 to MA 150	Move to attitude 180/0, Jan 31

Please don't uplink to B, MA 220-230. Interferes with mode S.

Lou McFadin W5DID (left) brought a special surprise guest to the AMSAT Forum held at Hamcomm in Arlington, Texas last June. He is Serge Krikalev, U5MIR, who spent 5 months on the mir Space Station. Serge is to fly on Shuttle Mission STS-60 in November. (WA5ZIB photo).

Barry Goldwater, K7UGA, makes a point to AMSAT President Bill Tynan, W3XO, during a recent visit to film a part of a promotional film for Phase 3D. (WA6ITF photo).

ELEVENTH ANNUAL AMSAT SPACE SYMPOSIUM

OCTOBER 8, 9, AND 10TH, 1993 LA QUINTA INN ARLINGTON, TEXAS

Hosted by the North Texas AMSAT Members

THURSDAY MORNING, OCTOBER 7TH:

Meet at La Quinta Inn at 9:00 a.m. and visit various electronic surplus stores in the Fort Worth/Dallas area. Transportation and expert guide will be provided.

FRIDAY MORNING, OCTOBER 8TH:

Registration begins at the La Quinta Inn. An antenna test range will be set up near the hotel, so bring your new antenna design and test it out.

FRIDAY AFTERNOON, OCTOBER 8TH: * DUAL LINE PROGRAM *****

(1) Presentation of the first of many outstanding AMSAT technical papers begins.
(2) ARRL Amateur Radio in Education Workshop hosted by Rosalie White, WA1STO, ARRL Educational Activities Dept. Manager.

FRIDAY EVENING, OCTOBER 8TH:

Rendezvous with your AMSAT friends and families at the La Quinta Inn and make dinner plans. This will be an excellent opportunity to sample the local Texas BBQ and Tex-Mex cuisine. Or just go to the stadium next door and watch the Texas Rangers in action.

SATURDAY MORNING & AFTERNOON, OCTOBER 9TH:

Enjoy a full day learning about what's new in AMSAT and what is planned for tomorrow. Topics include Phase 3D, Pacsats, DSP modems, and much, much more.

SATURDAY EVENING, OCTOBER 9TH:

Start out the evening with the traditional "attitude adjustment" hour followed by an enjoyable banquet dinner. As usual, the keynote speaker planned for this year will impressively entertain you.

SUNDAY, OCTOBER 10TH:

If you can spend another day with us, we've planned a series of technical sessions on various topics including the traditional Beginners Forum. And don't forget about the open Board of Directors meeting in the afternoon.

TO REGISTER: 1. Choose Plan A or B on the registration form below and check the appropriate box.
2. Enclose a check for the amount of the plan you choose.
3. Call the La Quinta Inn at no charge to reserve your room. Their toll-free number is 1-800-642-4239.

Call before Sept. 24 to get special rates of $50 single, $55 double, or $60 Triple/Quad. Suites are available. You can obtain an additional 5% discount off of discounted American Airlines flights by mentioning the "Star File" number: SØ5O3FT.

MAIL TO: 1993 AMSAT SYMPOSIUM, Route 1 Box 291, WACO, TX 76712

==========

PLAN A -- Registration $15 **PLAN B -- Registration and Saturday Night Banquet $35**

____ Check here if you will attend Thursday Surplus Tour

NAME:_____ CALL:_____

ADDRESS:_____ (PLEASE PRINT)

CITY:_____STATE:_____ZIP:_____

You may also register with the AMSAT OFFICE by mail or by phone.
AMSAT-NA, 850 Sligo Ave., Suite #600, Silver Spring, MD 20910 (301) 589-6062

MASTER CARD AND VISA ACCEPTED

Heard on the Downlink

by John Hansen, WAØPTV

The Dallas AMSAT Symposium

The AMSAT Annual Meeting and Space Symposium will be held this year on October 8-10, 1993 in Dallas, Texas. You probably already received a formal announcement and registration form in the mail. If not, a copy is contained elsewhere in this issue. I mention this here because over the past few years I've found the Symposium to be one of the highlights of my year. If you were under the impression that the annual meeting was only for the most active and informed members of AMSAT and that beginners or those with only modest satellite experience would neither understand nor benefit from attending, then you are under the same misapprehension that I was some years ago.

The first AMSAT meeting that I attended was the one in 1989 in Des Moines, Iowa. There was considerable excitement in the air, since the microsats had just been launched, and indeed there were a large number of interesting presentations on the satellites themselves and on the launch campaign. But what really impressed me about that meeting was the quality and variety of presentations on a host of topics. There was a parade of folks who came through to discuss their ongoing or proposed projects. Now many of these projects never did fly (or have not as yet flown) but just listening to a description of satellites sailing on the solar wind as a part of a race to Mars, or a satellite the size of a pizza box designed to be pitched out the door of the space shuttle was great fun.

It was at this meeting or the one the next year in Houston that Karl Meinzer discussed possible launch opportunities for what we now know as the Phase 3D project. At the time there were something like 200 applicants for the test flights on the new Ariane V launch vehicle. Karl predicted that most of these would fall by the wayside and that we would then have a good shot at perhaps the second launch. It is amazing how close to the mark he came.

Since that time I've tried to make every one of the annual meetings when the airfare was not prohibitive. There are three good reasons for you to consider going to Dallas this year even if you have never previously attended an AMSAT Symposium.

First, of course, is the quality of the papers. While many of these papers will cover technical topics, virtually without exception they will do so in a way that will be understood by those of us who are not engineers. What the papers will do is allow you to understand satellite operation better and give you a glimpse into the future to see what is coming down the road 2 to 4 years from now. Go and listen to the dreams of some very creative people and perhaps you can help make them come true.

Second, the meetings will provide you with practical information that you can use right away to set up or expand your existing satellite station, perhaps saving you a lot of money in the process. Often these hints come not as a part of the formal proceedings, but from comments picked up in the hallways or added by members of the audience. The purchases that I have made for my own station have been heavily guided by information I've picked up at AMSAT meetings. Many of the tips included in this column have been generated by the eavesdropping I do at the annual meeting.

The third reason for attending the meeting is to meet people who can help you with your specific problems or who you can later call for advice. There's just no substitute for knowing who to call and the annual meeting can give you a very good idea of who really knows what they are talking about.

I hope you to meet you in Dallas.

Revisiting the G5400 Rotator

Just before Field Day, after I had written the article for the last issue on the Yeasu G-5400 rotator, mine failed. As a result I obtained some first hand experience taking it apart and repairing it. The symptoms that mine came down with were that it worked fine a good port of the time, but occasionally would move only 30-40 degrees and then stall. The stall would occur at different places during the rotations, so it seemed that it did not occur as a result of an fixed obstruction in the rotator itself. Furthermore the problem was intermittent. As the rotator warmed up, it became more likely to fail.

Unfortunately it failed just 2 days before Field Day, and the thought of the rotor failing during the contest itself was too horrible to contemplate. So we cracked it open to attempt to figure out what was wrong. Disassembly, particularly with the "exploded view diagram" in the manual, turned out to be relatively pain-free. Like most rotators, the G-5400 runs from a high speed motor that is geared down to provide the torque needed to turn the antennas. Fitted onto the shaft of this motor is a pinion gear. The pinion gear fits snuggly on the shaft with grooves in the gear matching the grooves on the motor shaft. The pinion gear is made out of some kind of plastic and over the years the grooves on the gear had become stripped. As the rotor warmed up, the differential expansion of the shaft and the gear caused the gear to slip on the shaft and no longer turn the antenna. The pinion gear is designed to be removed by pulling it directly off the shaft (but it requires a fair amount of force to do so). So there we were two days

before Field Day, desperately in need of a new pinion gear. We called Yaesu and as it turned out they had one in stock. Total cost: 62 cents for the part and almost $25 for overnight shipping. The Yaesu folks were a pleasure to deal with and by noon the next day the rotator was repaired, reassembled and working. Sure beats returning it for service. If you experience a similar problem I would recommend taking it apart to see if you can repair it on-site.

Permanent Holes

If you work either UoSat 22 or Kitsat perhaps you noticed that every now and then you would get directory holes that could not be filled. Your system would just keep asking for the same directory fill over and over, but you would never get an "Up to Date" message. The only way to fix the problem was to edit your PFH-DIR.HOL file and remove all but the last hole listed. Perhaps you've also noticed that this does not happen anymore. I received a note from Jeff Ward explaining this strange behavior and why it has disappeared:

With any luck, a bug I recently fixed and told the Koreans about should stop these "permanent" directory holes from happening. It turned out that we had "FILES=10" rather than "FILES=20" even though we thought we had "FILES=20". So from the very beginning of the KITSAT mission (and very recently on UO-22) we have had some occasions where files could not be opened correctly at peak periods. This means that sometimes a file will get its PFH [Pacsat file header -ed] chopped off and that causes a permanent directory hole.

I think it is fascinating that the satellite is suseptible to the same kind of errors I've run into on my own PC!

PB for the Mac

I received a note from Ron Cox, W9KFB who has been running PB on his MacIntosh computer using SoftPC, an MS-DOS emulation program. He has a Mac II with 8 megs of ram running System 7. PB seems to run just fine under the emulator, but PG (the file upload program) does not because it requires hardware support of the DCD line, which apparently, the Mac does not provide. If anyone has any suggestions, please contact Ron, and don't forget to send me a copy.

Corsica Qsl Cards

There has been some confusion about the QSL route for the Corsican satellite DXpedition TK5CI. According to Jean-Yves Mulot, F1HWB, cards sent to the Corsican Bureau will not be answered because they are not finding there way to him. F1HWB is the only QSL route for this DXpedition. His address is 20 Res. Montjoie, 50140, Mortain, France.

Internet

In the proceedings of the last AMSAT Space Symposium there was a paper by Tom Clark (W3IWI) on accessing AMSAT information via Internet. Many of us have Internet connections through our employers, but many more AMSAT members do not. Aside from getting the latest, up-to-date AMSAT information and electronic mail services, Internet also provides access to an incredibly wide array of files, programs and services. The possibilities are almost staggering. As Tom mentioned in the paper, it is possible to get AMSAT news and E-mail services indirectly through Compuserve and other on-line services, but in most cases you can not FTP or Telnet this way (FTP and Telnet are the mechanisms used for obtaining files and logging on to other Internet computers). Tom did mention some sources of full Internet service, but the cost of these is generally higher than the connect time on services like Compuserve or America On-line.

It was with great interest that I saw an advertisement in the *Computer Shopper* for the on line service called "Delphi" which is now claiming that they offer a full Internet connection including FTP, Telnet, and Usenet. Shortly after reading this I received an E-mail message from an Argentine ham who was looking for some rotator information. When I tried to respond (using a number of different address possibilities) the mail bounced. I'm sure it must be possible to send return mail over this link, I just haven't figured out how to do it. If you have had any experience using the Delphi/Internet link I would appreciate it if you would drop me a note about it.

AMSAT News Service BBS

Mel Roman, KA2UPD, is the sysop of a new telephone BBS that has been adopted by the AMSAT News Information Service. Full information on this resource, including a tutorial on how to use it will be contained in an upcoming issue. However, I thought I'd provide the basic information this issue so you could get started with it right away.

Mel calls this the AMSAT SATS & STATS BBS and it contains all the latest news from the AMSAT News Service as well as keplerian elements, KB2BD's Spacenews, and a lot of software and files of interest to satellite operators. In the coming months he will be adding a graphics interface called RIPGRAPHICS. I recently read a review of this in one of the computer magazines and it seems clear to me that it will revolutionize phone BBS's when it gets going. SATS & STATS can be reached at 201-261-2780, 24 hours a day, 7 days a week. You don't have to be an AMSAT member to check in (but is sure would be nice!).

Software of the Month

Last month I mentioned SATSKED, Wayne Roth's program for interfacing with digital satellites. Shortly after I wrote that column Wayne generously decided to use the program as means of raising money for Phase 3D. For information on the latest version of this program you should contact WA2N directly.

Another program for automating your digital satellite station has been developed by Tim Miller, KG4TM. It is called Satellite Auto Select (or SAS) ver. 1.15. It

interfaces with both InstantTrak and Quik-Trak to fully automate the process of switching between satellites and performing most of the other chores necessary in a fully automated digital station. It avoids the use of routines that stuff keystrokes into your buffer at specified times and is thus more Desqview-friendly than other programs. It is available for download from KitSat, or you can send a disk mailer and return postage to me.

I Need Help

You may have noticed on the front page of this issue that I have been appointed Editor of this Journal. Barely six months on the job and promoted already! Things happen fast in the realm of high technology. I inherited a first rate group of assistant editors when I took over this job, but I need some help with some special projects. Here is your chance to do something to help AMSAT without signing on for the rest of your life. I am currently looking for help with the following projects:

1. AMSAT Journal Index. If you have been receiving this Journal for the last couple of years, you can help by putting together an index. Toward the end of this year I would like to print a listing of all articles that have appeared in the AMSAT Journal over, say, the past three years. It would also be nice to include the contents of the AMSAT Symposium Proceedings. The entries should be organized by topic, perhaps with a one line description of the contents. If you would like to take on this task and are missing a couple of issues, we may be able to find them for you.

2. I want to establish a "beginner's column" in the Journal. This column would take a set of related questions from someone just getting started and provide that individual with an upgrade path from his or her current station to the satellite on which they would like to become active. To get this underway, I need a small group of folks who I can rely upon to read over the questions and make recommendations. If you would like to be included on this panel, send me your name and the areas in which you have expertise. Given the need for rapid communication within the panel, I need to find folks for this job who are active on E-mail (Internet, Compuserve, etc.)

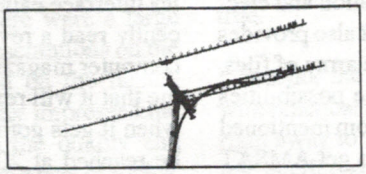
3. I need some production people for occasional assignment. For example, I would like to find someone I can call on from time to time who has professional quality graphic artist skills. In addition, from time to time I could use the skills of a good typist. These would be very occasional duties, but if you can help in either of these capacities, please drop me a note.

4. I would like to include a few constructions projects in the Journal. For example, I think it would be fun to publish a 2 meter preamplifier that we could all build for Mode B. It should have a noise figure of under 1 dB, be capable of switching 200 watts of RF and should be capable of being powered through the coax or through a separate 12 volt line. Any takers?

5. Of course we are always looking for articles.

If you can help with any of these projects contact me at:
hansen@jane.cs.fredonia.edu
Compuserve: 70353,460
U.S. Mail: 49 Maple Avenue,
Fredonia, NY 14063

DOWN EAST MICROWAVE



MICROWAVE ANTENNAS AND EQUIPMENT
• Loop Yagis • Power Dividers •
Complete Arrays • GaAs FET Preamps
• TROPO • EME • Weak Signal • OSCAR •
Microwave Transverters
432 902 1269 1296 2304 3456 5760 MHz

2445 LYK 45el 1269 MHz 20dBi $ 95
1245 LYK 45el 2400 MHz 20dBi $ 79
2455 LYK 55el 1269 MHz 18.5dBi $108
Above antennas kits available assembled.
Add $ 8 UPS S/H
Add $11 UPS S/H West of the Mississippi

MICROWAVE LINEAR AMPLIFIERS SSB, ATV, REPEATER, OSCAR

2316 PA 1w in 18w out 1240-1300 MHz $265
2335 PA 10 in 35w out 1240-1300 MHz $325
3318 PA 1w in 20w out 900- 930 MHz $265
3335 PA 10 in 40w out 900- 930 MHz $330
23LNA preamp 0.7dB N.F. 1296 MHz $ 95
33LNA preamp 0.9dB N.F. 902 MHz $ 95

NEW PRODUCT ANNOUNCEMENTS

New Loop Yagis
1845 LY Loop Yagi 1691 MHz 20dBi $105
945 LY Loop Yagi 3456 MHz 20dBi $ 93
Above antennas assembled and tested

New preamps

13LNA 0.7dB N.F. 12 dB 2.4 GHz $140
18LNA20 0.8dB N.F. 20 dB 1.69 GHz $140
SLNA 1.0dB N.F. 10 dB 2-2.7 GHz $150

New Wideband Power Amplifiers

2370 PA 3w in 70w out 1240-1300 MHz $695
2340 PA 2w in 35w out 1240-1300 MHz $355
2318 PAM 1w in 18w out 1240-1300 MHz $205
Rack mount Amplifiers for repeater use available

NO TUNE MICROWAVE LINEAR TRANSVERTERS

From SHF SYSTEMS a new line of transverters designed by
Rick Campbell KK7B and Jim Davey WA8NLC

Available in kit form or assembled/tested

- 903 1269 1296 2304 3456 5760 MHz
- microstrip filters eliminate tune-up
- 2m i-f, PIN diode switched
- sequencer standard in complete unit
- low profile packaging, mast mountable
- now available, 70cm no-tune transverter and linear amp.

All active equipment - 13.8V

DOWN EAST MICROWAVE
BILL OLSON, W3HQT
Box 2310, RR-1, Troy, ME 04987
Phone: (207) 948-3741 • FAX: (207) 948-5157

AMSAT Publications

Satellite Experimenters Handbook:
By: Marty Davidoff, K2UBC
A must for every Satellite enthusiast's bookshelf. Covers; history, fundementals of station construction, tracking as well as advanced topics. $23/25/30

PACSAT Beginner's Guide:
By Mike Crisler, N4IFD
Step by step instructions to becoming PACSAT-active. $12/13/15

Beginners Guide to AO-13:
By Keith Bergland, WB5ZDP
Step by step instructions to becoming active on OSCAR 13. $7/8/10

Beginners Guide to the RS Satellites:
By Gould Smith, WA4SXM
Step by step instructions to becoming active on the RS Satellites. $7/8/10

Decoding Telemetry from the Amateur Satellites:
By Gould Smith, WA4SXM
Describes the telemetry systems of each of the current Amateur Satellites - thru AO-21 and RS12/13. $15/19/25

Weather Satellites Handbook:
By Ralph Taggart, WB8DQT
Describes the how-to's of receiving commercial weather satellite images on "ham accessable" equipment. Similar in scope to the Satellite Experimenter's Handbook. $23/25/30/35

Pricing Key: US/Canada & Mexico/Europe & South America/Far East

Name: _____
Call: _____
Address: _____
City _____
State/Prov: _____ ZIP/PC: _____
Membership #: _____
VISA/MC #: _____
Exp. Date: _____
Signature: _____

Mail to: *AMSAT*, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703, **or** FAX to: (301) 608-3410

A Case for the 5.8 GHz Band

By: Graeme Wilson , VK4FXL
VK4FXL@VK4CXX.BNE.QLD.AUS.OC

This article first appeared in AMSAT-UK's Oscar News, Number 101, June/July, 1993

Introduction

The purpose of this article is to propose primary allocation status for the 5 GHz Amateur band on a worldwide basis.

Most Amateurs are not aware that there are no primary allocations between 148 MHz and 47 GHz worldwide and many of the existing UHF and SHF bands are virtually unused. From my experiences and being employed in the microwave industry it has occurred to me that the 5 GHz Amateur band has the potential to become one of the great bands in the same sense that 20 meters is on HF and 2 meters on VHF. Being a microwave frequency means it is basically a line of sight frequency but the band has enormous potential in areas like satellite communications, repeater links, both voice and digital, terrestrial backbones, remote site control, remote station operation, which is currently not permitted, ATV inputs and ATV in general and very high speed data transmissions up to 2 Megabits per second.

There is always pressure on the Amateur bands by commercial users and indeed one band is slowly being eroded here in Australia without anyone being aware of it.

I would like to elaborate on the potential of the 5.8 GHz band.

Satellite usage

This will in time become the most used Amateur satellite frequency because the band plan has been brilliantly set up (by persons unknown) and presented to a WARC conference. It is the only microwave band with both uplink and downlink allocations, which means only one antenna and one feed are required. It is only logical that circular polarity must be used for satellite communications and this is simple to achieve. The band is ideally suited to using parabolic dishes no more than 1.2 m in diameter. This will give a gain of 34 dBi and a beamwidth of 3.0 degrees. The diameter of 1.2 m or 4 feet is chosen from standard widths of aluminum and is a compromise between wind loading, beamwidth, pointability, gain and visual appearance. In this day and age everybody has to be aware of other people's opinions and accept that what may be a magnificent looking creation to us may be an eyesore to others. Let us look a little closer at the beamwidth vs pointability area. Figure 1 compares the bands between 1 and 10 GHz.

Beamwidth, Waveguide, and Polarization

The bands that are going to be used in the near future are 1260 and 2400 MHz for mode S and clearly the beamwidths are too wide and most of the power generated is going to be wasted. At the other end, 10 GHz, the beamwidth is just a bit too narrow and the system will be a bit difficult to aim. 5 GHz seems to offer the best compromise on beamwidth. No doubt commercial manufacturers of rotators and elevators will produce equipment with greater pointing accuracy than is currently available.

The feed can be a simple circular waveguide with splash plate arrangement. The waveguide is no more than a straight piece of 1.5 inch thin wall brass tubing and both left and right circular polarization can easily be achieved by strategically squashing the guide at 45 degrees to the two coax connectors. These two connectors are fitted at right angles to each other behind the dish. There is no need for any complicated phasing harness at all. The two coax ports will have at least 20 dB rejection of the

PacComm • Advanced Technology • Enduring Value

Packet Satellite Modems

PacComm has the most options for 9600 bps satellite work.
All built from the G3RUH Direct FM design.

- The MC-NB96 modem card fits any PacComm TNC, or TNC-2 clone.
- The EM-NB96 external DFM modem easily attaches to all AEA and MFJ TNCs - allows push button selection of 1200 AFSK, 9600 DFM, and two auxiliary modems including the PSK-1 modem for 1200 bps satellite work.
- The TNC-NB96 is a fully capable 1200 bps AFSK and 9600 BPS unit in one case - push button selection of speeds and modes, no cable switching. Supports PacComm's PSK-1 Satellite Modem too.

PacComm has two ways to go for 1200 bps MicroSat access.

- The PSK-1 modem for attachment to most any TNC, or to add on to the TNC-NB96 described above.
- The PSK-1T with a built-in TINY-2 TNC. As simple to connect an any ordinary TNC.

PacComm Packet Radio Systems, Inc.
4413 N. Hesperides St., Tampa, FL 33614-7618
(813) 874-2980
Facsimile (813) 872-8696 Amateur Orders (800) 486-7388

other polarization which will make the filtering much easier.

Local Oscillators

Now take a pen and paper and work this out. Start with a 100 MHz crystal. Multiply x3x3x3x2 to 5400 MHz. Now look at the satellite downlink allocation 5830 to 5850 MHz. Subtract the 5400 MHz LO from 5830 MHz and the result is 430 MHz. Subtract from 5850 and the result is 450 MHz. This is one of the greatest advantages of using this band. If 70 cm is used for the downlink, then we have digit for digit compatibility assuming we disregard the 400 part.

There is a similar relationship with the uplink. Take the same 100 MHz crystal, x11x2x2 to 4400 MHz. Use this figure as a TX LO and add 1250 MHz. This gives us 5650 MHz which is the bottom of the uplink band. Add 1270 MHz to get 5670 MHz, the top of the band. Again we have digit for digit compatibility with 23 cm equipment. Brilliantly thought out??? Thank you to the people responsible for this. Another factor is that the 100 MHz crystal can be phase locked to PAL TV horizontal sync pulses which at least here in Australia are all referenced to a rubidium standard in Sydney. It may not be quite so easy in other countries which do not use 15.625 kHz as a line frequency.

Doppler and Tracking

The problem of Doppler shift now arises. Having a phase locked 100 MHz oscillator is fine for a stationary satellite but it may be many years before there is a geostationary amateur satellite or even the next best alternative ,a module hitch-hiking on a commercial satellite. So we look at the worst possibility for Doppler, a LEO (low earth orbiting) satellite like the pacsats currently in orbit. The Doppler would be in the order of + and - 125 kHz from AOS to LOS and would be nearly impossible to acquire and then track manually. So this band may not be suitable for LEO satellites. From here we go to highly elliptical orbits and rely on the satellite always pointing at the earth as is proposed for P3D. The transmitter would have to have a beacon at the band edge as is current practice.

Now in the back of our dish on the ground. We have a 5.8 GHz downconverter coming out at 430 odd MHz and feeding down a coax to the shack. Rather than just feeding one receiver, it should go to a tee junction and then to two 75 ohm coax cables one quarter wavelength long and finally to two receivers. One could be an obsolete FM two way radio modified to receive 70 cm. Virtually all FM two way radios that I know of have a decoder IC with analog AFC output. Use this receiver only to lock on to the beacon and provide AFC back to the 100 MHz crystal. That way both the uplink and down link frequencies will track. There will be some inaccuracies with the transmit frequency as it is 180 MHz away from the receive frequency, but this should not present too great a problem in manual tracking.

Other Uses

As we will see in future years, 5GHz is an optimum band. Now we shall discuss other uses for the 5 GHz band. Being a microwave frequency does mean it is virtually only a line of sight band, so QRM should never be much of a problem. It is well suited to repeater linking, both voice and digital, terrestrial backbones, remote control of remote sites and ATV. Because of the high gain available through antennas, surprising results can be achieved with very low power. For example, a narrow band FM transmission using 10 mW into a 200 mm diameter horn will have a 46 dB signal to noise ratio at 100 km if the receiver has the same sort of horn. 10 mW of power is readily achievable using FETs like the MGF1302. Gunn diodes are well and truly obsolete and should not even be considered. Also permitted in the microwave bands are the wide band modes like ATV and high speed digital data.

Very High Speed Data Rates

Data rates of 2 megabits per second are routine in commercial applications, but will probably never be used on Amateur Radio. However, rates of 64,000 or preferably 96,000 bits per second may take off. Think about this. I have chosen 64,000 bps as it is the standard for one telephone voice channels, i.e. 8 bits sampled 8000 times per second. In commercial applications, these channels are grouped together and have separate synchronizing bytes. But if we have 8 data bits, irrespective of whether it is voice or packet type data and add one sync bit at the start and 3 EDAC bits at the end, we have 12 bits. Thus the new data rate of 96,000 bps. This will allow either one voice channel or, much better, a packet data rate of 8,000 bytes per second, or 28.8 megabytes per hour.

Think about the average packet bulletin size of one or two kb. It could be delivered in about a quarter of a second, and be error free, courtesy of the Error Detecting And Correcting bits on the end of each byte. It may even be possible for a packet bulletin board to transmit continuously in a broadcast mode similar to what UO-22 and KitSat do. The bandwidth needed is actually not that large. There is a technique used commercially called HDB3 which halves the bandwidth required. A 96,000 bps transmission would use a fundamental frequency of 48,000 Hz because each half of the sine wave is used to represent a bit. If a zero is to be sent, then one half of the sine wave is not sent. It is a little bit more complicated than that, but that is the essence of how it works.

Finally

From the arguments I have presented above, I hope that I can convince people to press for the 5 GHz band to be made a primary allocation. It is vitally important that at least one band between 1296 MHz and 10 GHz becomes a primary allocation, and I have chosen to argue the case for 5 GHz simply because it ALREADY has both an uplink and a downlink allocation for satellite use. All the other reasons fall in behind this one reason. It is achievable; much great work has been done by persons unknown at previous WARC conferences. We must not allow their work to become undone. Populate this band and assist AMSAT to put 5 GHz transponders in space.

I welcome any feedback and am considering a routine packet newsletter concerning VK Microwave News.

Frequency	Gain (dBi)	Beamwidth
1260	21.1	13.9
2400	26.7	7.3
5850	34.3	3.0
10450	39.5	1.7

Figure 1: Typical Beamwidth for Different Bands

INSTANTTRACK UTILITIES

A disk of utility programs. IT users will find some very useful. Pacsat users will appreciate the two KISS related files. The single disk contains the following:

ITPASS - Outputs a table of upcoming passes with AOS, LOS and maximum EL.

ITSORT - Rearranges IT's satellite database using your own text editor.

ITSTAMP - Adds AZ/EL/RANGE to a timestamped ASCII log file.

DISPANG - Displays OrbitDRV antenna angles in upper right corner of screen.

DUMMYKCT.ZIP - Assembly language source for the dummy RotorDRV.

DRVSVC.DOC - Specification for the Kansas City Tracker software interface.

KCTHW.TXT - Reverse-engineered hardware data on the Kansas City Tracker.

KISS2ASC - Converts a KISS binary log file to readable ASCII.

KISSFILT - Selectively filters a KISS log file by callsigns, etc.

Members & non-members $15.

Satellite Orbital Elements

by Dick Campbell, N3FVK

Satellite	AO-10	UO-11	RS-10/11	AO-13	FO-20	AO-21	RS-12/13
Catalog Number	14129	14781	18129	19216	20480	21087	21089
Epoch Time	93221.06889999	93223.60658007	93220.43284199	93224.27091345	93213.62679476	93222.78919451	93219.09473796
Element Set	15	428	638	629	452	824	412
Inclination	27.0868	97.8094	82.9203	57.8324	99.0320	82.9432	82.9222
RA of Node	11.8398	247.5503	199.9896	300.6605	61.1953	12.4120	244.3622
Eccentricity	0.6022186	0.0011577	0.0011538	0.7221196	0.0541077	0.0034219	0.0027716
Arg of Perigee	104.2478	173.9570	165.4463	321.6701	343.7838	228.0928	264.3337
Mean Anomaly	326.2403	186.1778	194.6995	4.7572	14.6522	131.7291	95.4657
Mean Motion	2.05882066	14.69038330	13.72321524	2.09728364	12.83220426	13.74523258	13.74025097
Decay Rate	-.00000019	.00000198	.00000088	-.00000222	-.00000013	.00000084	.00000019
Epoch Rev	7635	50485	30701	3953	16314	12694	12551

Satellite	ARSENE	UO-14	AO-16	DO-17	WO-18	LO-19	UO-22
Catalog Number	22654	20437	20439	20440	20441	20442	21575
Epoch Time	93220.71127607	93218.73957688	93218.73756346	93218.79218351	93219.25219564	93219.25085967	93219.08053576
Element Set	19	760	565	567	569	566	265
Inclination	1.1442	98.6130	98.6207	98.6211	98.6209	98.6211	98.4703
RA of Node	124.5650	302.4541	303.3807	303.6596	304.1374	304.3215	294.3668
Eccentricity	0.2935408	0.0011877	0.0012226	0.0012298	0.0012876	0.0013238	0.0007975
Arg of Perigee	146.5525	37.2541	38.3084	37.9561	36.3969	35.7691	140.7748
Mean Anomaly	234.2699	322.9463	321.8965	322.2477	323.8080	324.4369	219.4029
Mean Motion	1.42202880	14.29785557	14.29844227	14.29980426	14.29959852	14.30050311	14.36842996
Decay Rate	-.00000049	.00000038	.00000033	.00000031	.00000031	.00000038	.00000062
Epoch Rev	132	18465	18466	18468	18475	18476	10797

Satellite	KO-23	NOAA-9	NOAA-10	NOAA-11	NOAA-12	NOAA-13	MIR
Catalog Number	22077	15427	16969	19531	21263	22739	16609
Epoch Time	93220.36901674	93225.13001766	93225.02149067	93225.17583930	93225.08005572	93222.31462920	93225.30506279
Element Set	110	437	279	188	645	10	238
Inclination	66.0839	99.0962	98.5158	99.1366	98.6545	98.9084	51.6211
RA of Node	214.9336	266.2840	238.3481	202.1117	254.1323	163.5700	292.6322
Eccentricity	0.0001040	0.0015552	0.0013506	0.0011086	0.0013932	0.0008992	0.0003995
Arg of Perigee	164.0942	11.4673	144.9194	281.5802	51.5484	280.7119	335.3009
Mean Anomaly	196.0109	348.6831	215.2920	78.4144	308.6941	79.3074	24.7837
Mean Motion	12.86279781	14.13538095	14.24826715	14.12905754	14.22298273	14.10849591	15.59205257
Decay Rate	.00000000	.00000083	.00000045	.00000163	.00000166	-.00000019	.00007293
Epoch Rev	4655	44682	35872	25172	11673	12	42804

Monitoring AO-13 Battery Voltage

by Graham Ratcliff, VK5AGR

In the past James Miller, G3RUH, or I have described how many variables have to be considered by the Command Stations in managing the health of AO-13. One of the most important variables is the battery voltage.

AO-13's OnBoard Computer (OBC) can be programmed to collect telemetry data during the whole orbit and this is known as Whole Orbit Data (WOD). In the case of AO-13 this is 'dumped' or stored in the 'K' blocks which are transmitted on AO-13's beacon(s) using 400 baud PSK. Using an IBM-PC running a program called P3C.EXE in conjunction with a 400 baud PSK demodulator this telemetry can be stored on disk. Then using a simple BASIC program the data can be converted into graphs as shown in Figures 1 and 2.

In Figure 1 the WOD was collected from the perigee on orbit 3801 until well into orbit 3812. The vertical lines going through each orbit number represent the start or perigee of each orbit.

The 'On Period MAs' numbers indicate the amount of Mode-B transponder operation that was programmed for each orbit. For instance, on orbit 3801 the Mode-B transponder was switched ON for the whole orbit, i.e. 256 MA units. On orbit 3805 the Mode-B transponder operation was limited to only 160 MA units but you can see from the graph that the battery voltage still dropped below 13 V due to the transponder loading and as the bottom line indicates the Sun Angle was 42 degrees.

On orbit 3806 the Mode-B ON time was reduced to only 60 MA units and even with a Sun Angle of 44 degrees the battery voltage did not drop below 13 V. However, on orbit 3807 with the Mode-B ON time reduced to only 50 MA units and a Sun Angle of 45 degrees the battery voltage dropped to the low voltage trip point of 12.5 V which immediately switched the transponder to its low power mode (-3 dB).

From the graph it is interesting to note that AO-13 tripped (switched) to the low power mode on each of the odd-numbered oribits 3805, 3807, 3809 and 3811. On the even-numbered orbits the battery voltage either remained above 13 V or just dipped below 13 V. The reason is that on the odd-numbered orbits AO-13 was in view of both the USA and part of Europe while on the even-numbered orbits only those parts of the world where people are likely to be asleep were in view. To confirm this I suggest that you run InstantTrack for AO-13 in fast forward mode from 02 June 93 at 2200 UTC to 03 Jun 93 at 2200 UTC in order to see what coverage AO-13 had on orbits 3805 to 3806. Obviously the highest loading is when AO-13 is in view of the USA and at hours when 'normal amateurs' are likely to be up and about.

One of the unfortunate things that happens to AO-13 when it switches to the low-power mode is that users tend to increase their uplink power in an attempt to improve their downlink signal which only aggravates the low battery voltage situation and the battery voltage drops even lower to the point where the OBC switches the Mode-B transponder OFF!!!

Now available from AMSAT

The PACSAT Beginner's Guide

Want to get on PACSAT?

Don't know how to get started?

Written in a conversational style, this new AMSAT publication is almost like having a PACSAT Elmer on your bookshelf. It takes you from the conception of the store and forward satellite thru to the fine details of PACSAT operation.

You don't have to be an experienced satellite operator to use this booklet. It starts with a description of what a PACSAT station consists of and then, step by step, walks you through receivers/converters, transmitters, antenna and coax selection, preamps, TNC requirements, and finally tracking. Once your station is set up *The PACSAT Beginner's Guide* explains the vaious software programs needed to operate successfully through the birds. Included is a 5¼ inch PC compatible diskette.

Come be part of the cutting edge of Amateur Radio technology. The PACSATs are waiting to hear from you.

Available from AMSAT Headquarters, (301) 589-6062.

U.S. $12.00
Canada $13.00
Elsewhere $15.00

AMSAT
Box 27,
Washington, D.C. 20044

Figure 2 shows some slightly different conditions affecting AO-13's battery voltage. During orbits 3815, 3816, 3817, 3818 and 3819 magnetorquing was in progress from MA 224 through perigee to MA 031. Also AO-13 was subjected to solar eclipses from MA 251 through perigee to MA 003. However, the Sun Angle was never below 37 degrees so the battery voltage rarely dropped below 13 V.

Readers may wonder why there was a low voltage trip on orbit 3819 but not on orbit 3816 or 3818 when from the graph the voltage appears lower on those orbits than on orbit 3819 when a low-voltage trip occurred. The answer lies in the fact that the OBC only collects data for the WOD file every 8 MA units, so the battery voltage must have dropped to 12.5 V in one of the previous 7 MA units on orbit 3819.

Now that the Mode-L transponder, which had a high current drain, has failed the battery voltage will be closely monitored to see how this affects the power budget.

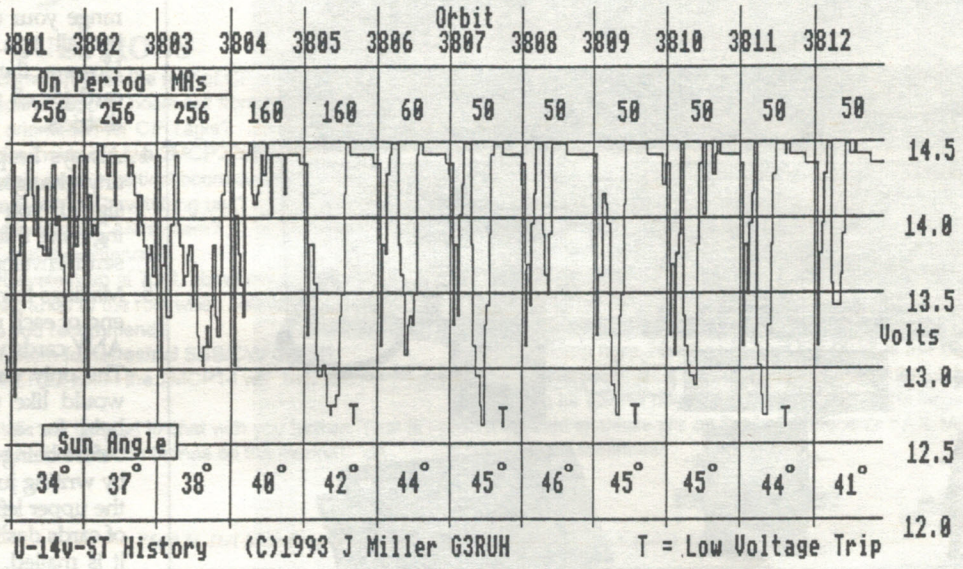


Figure1: Battery Voltage data for orbits 3801 to 3812

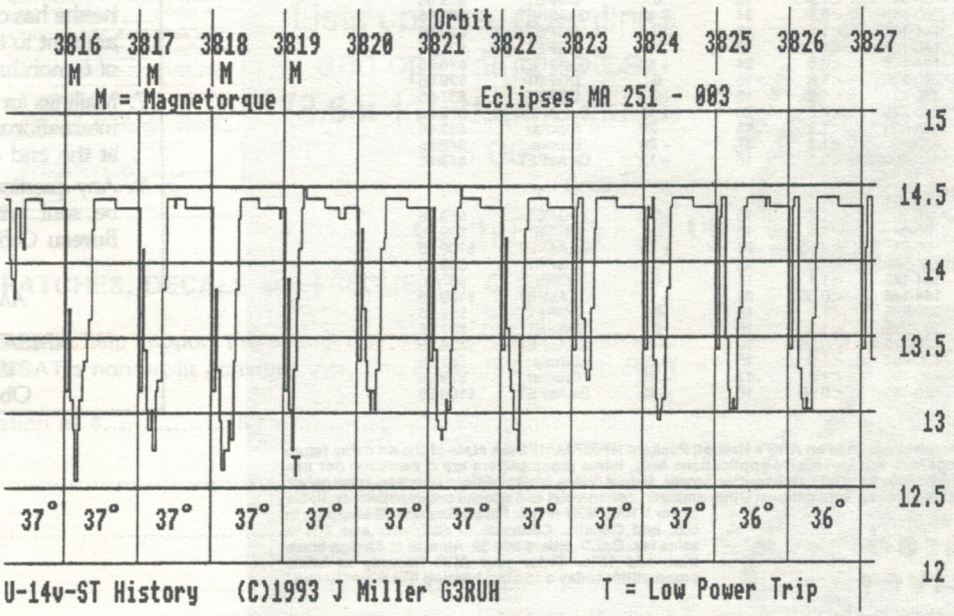


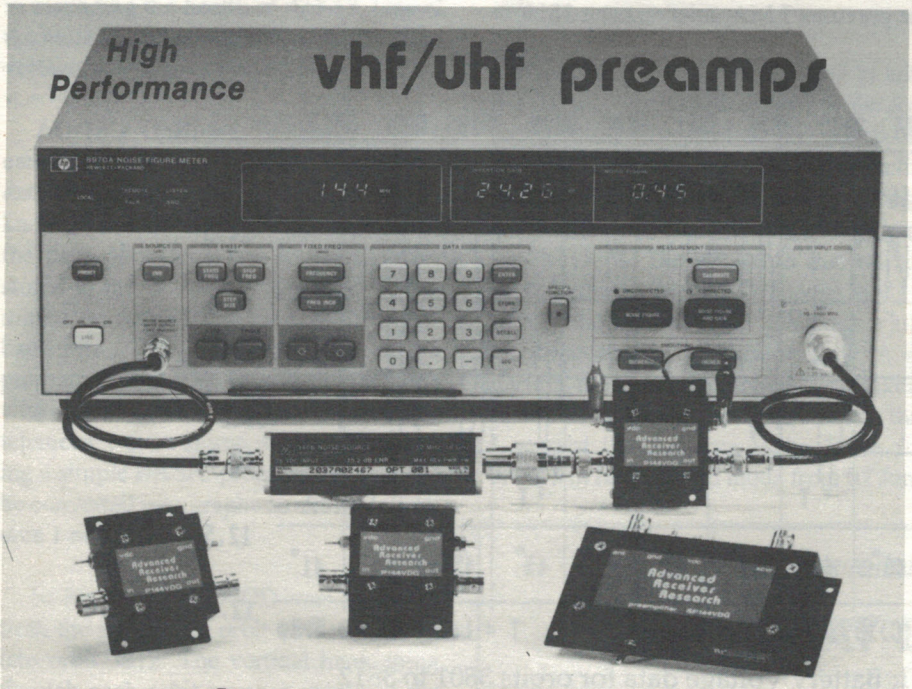
Figure 2: Battery Voltage for Orbits 3816 to 3827

AMSAT BBSs

If you wish to add your BBS to this list, contact:

JOHN WISNIOWSKI, N6DBF
COMPUSERVE: 70233,75

High Performance **vhf/uhf preamps**



Receive Only	Freq. Range (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
P28VD	28-30	<1.1	15	0	DGFET	$29.95
P50VD	50-54	<1.3	15	0	DGFET	$29.95
P50VDG	50-54	<0.5	24	+12	GaAsFET	$79.95
P144VD	144-148	<1.5	15	0	DGFET	$29.95
P144VDA	144-148	<1.0	15	0	DGFET	$37.95
P144VDG	144-148	<0.5	24	+12	GaAsFET	$79.95
P220VD	220-225	<1.8	15	0	DGFET	$29.95
P220VDA	220-225	<1.2	15	0	DGFET	$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	$79.95
P432VD	420-450	<1.8	15	−20	Bipolar	$32.95
P432VDA	420-450	<1.1	17	−20	Bipolar	$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	$79.95
Inline (rf switched)						
SP28VD	28-30	<1.2	15	0	DGFET	$59.95
SP50VD	50-54	<1.4	15	0	DGFET	$59.95
SP50VDG	50-54	<0.55	24	+12	GaAsFET	$109.95
SP144VD	144-148	<1.6	15	0	DGFET	$59.95
SP144VDA	144-148	<1.1	15	0	DGFET	$67.95
SP144VDG	144-148	<0.55	24	+12	GaAsFET	$109.95
SP220VD	220-225	<1.9	15	0	DGFET	$59.95
SP220VDA	220-225	<1.3	15	0	DGFET	$67.95
SP220VDG	220-225	<0.55	20	+12	GaAsFET	$109.95
SP432VD	420-450	<1.9	15	−20	Bipolar	$62.95
SP432VDA	420-450	<1.2	17	−20	Bipolar	$79.95
SP432VDG	420-450	<0.55	16	+12	GaAsFET	$109.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include $2 shipping in U.S. and Canada. Connecticut residents add 7-½% sales tax. C.O.D. orders add $2. Air mail to foreign countries add 10%. Order your ARR Rx only or inline preamplifier today and start hearing like never before!

Advanced Receiver Research

Box 1242 • Burlington, CT 06013 • 203 582-9409

AMSAT QSL Bureau

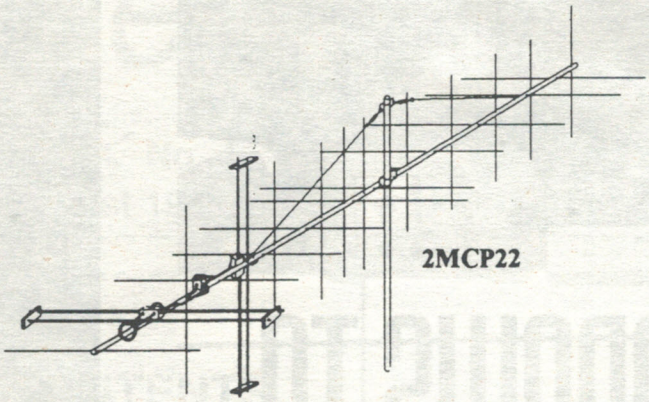
Rules for using the AMSAT OSCAR QSL Bureau.

1. The AMSAT QSL Bureau serves the users of all Amateur Radio Satellites with a complete QSL Bureau for all Amateur Radio satellite contacts (QSLs other than satellite QSOs will be returned).
2. Stations wanting to use the Bureau; arrange your cards ALPHABETICALLY by call sign. Stateside cards are free. However there is a charge of 5 cents per card for all stations outside US Postal districts.
4. Always keep the Bureau informed of any changes in your address or call sign. If you have worked stations using more than one call sign, you should send envelopes for both call signs.
5. Mailings from the Bureau will be at the end of each month. All envelopes with ANY cards will be mailed at this time. The only exception is if the Amateur would like to have his/her envelope held for a certain amount of cards before being mailed. This can be done by writing just below your call sign (in the upper left hand corner) the number of cards desired in the envelope before it is mailed.
6. QSL cards that are received at the Bureau when there are no envelopes on file will be held and the Bureau will make an attempt to notify the user that he/she has cards on file. If no envelopes are sent to the Bureau within a period of 6 months, the *cards will be destroyed!*
7. Mailings for DX stations and individual international QSL Bureaus will go out at the end of the month.
8. Any questions about the Bureau should be sent with an SASE to the QSL Bureau Office.■

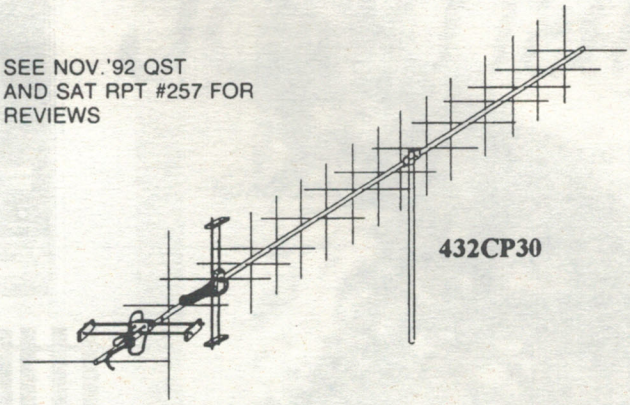
Perry Yantis, WB8OTH
AMSAT QSL Bureau Manager

AMSAT-NA QSL Bureau
1850 Lisle Ave.
Obetz, OH 43207

QUESTIONS AND ANSWERS (COMMONLY ASKED)



SEE NOV.'92 QST
AND SAT RPT #257 FOR
REVIEWS



QUESTIONS

1. Do the feedlines have to come off near the rear of CP antennas?
2. Can I mount a metalic feedline support boom out from the main boom?
3. What is the best element orientation for CP Yagis?
4. Can I mount two 436CP30s inside my two 2MCP22s?
5. Does the 2MCP22 absolutely need a vertical boom support?
6. Why doesn't M2 provide a RHC LHC switching unit?
7. Should I use a preamp with my OSCAR system?
8. Should I mount the preamp at the antenna?
9. I Can I mount my OSCAR system up at 70 ft. above my HF Yagis?
10. What is the minimum clearance to the roof when I elevate the array?
11. What kind of feedline do you recommend?
12. Can I use my OSCAR system for terrestrial SSB/CW or FM?
13. Why should I buy the 2MCP22 when the 2MCP14 will hear the OSCAR?

If you still have questions, We will be glad to chat with you further. That is how we add even more value to the finest antennas on the market!

ANSWERS

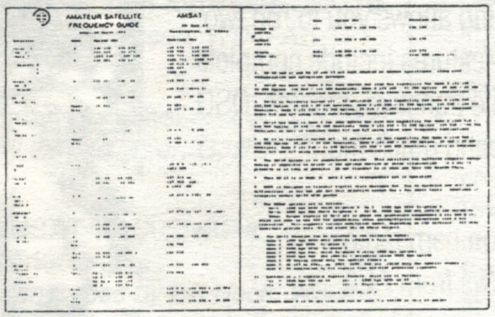
1. To avoid cutting the circular field that surrounds a CP antenna and disturbing the pattern and VSWR, the feed line should come off the rear.
2. Yes, Metal tubing supporting coax will have little effect on performance.
3. Any mounting works but for easiest feeline routing, the X shape works best.
4. No because the 2m antennas act like a shield and 70cm antennas suffer.
5. No, only in heavy Ice conditions, otherwise it is optional.
6. We have gone for reliability by eliminating a major loss and failure area.
7. A preamp will usually improve your signal to noise ratio on 2m and 70cm.
8. For feedlines over 50 feet, antenna mounted preamps are recommended.
9. Yes but for mechanical and maintenence reasons it is not recommended.
10. The reflectors should clear the roof by 4 to 6 inches.
11. Don't Skimp here. Hardline is best but 9913 is the best bang for the buck.
12. Absolutely! and CP is sometimes very helpful on terrestrial paths.
13. You will be able to hear the 'weak ones' with the larger 2MCP22.

More detailed answers are available by phone or FAX. We could probably write a book on CP antennas!

FAX, PHONE OR WRITE
FOR OUR FULL CATALOG
WE ALSO DO SPECIALS

M^2 Enterprises
7560 N. Del Mar Fresno, CA 93711 (209) 432-8873 FAX (209) 432-3059

WE TAKE VISA AND MC



AMSAT Trinkets

Laminated Frequency Chart
Lists uplinks, downlinks
and operating notes.
(8.5 x 11", double sided)
- $5.00 -

Cloth Patch - $5.00

(shown half-size)

***AMSAT* PATCHES, DECALS and FREQUENCY CHARTS**

These are being offered to help support the amateur satellite program. Proceeds will be applied to AMSAT's non-profit activities including Phase III-D construction.

Enclosed is my donation of $.....for .....

Name..... Call.....

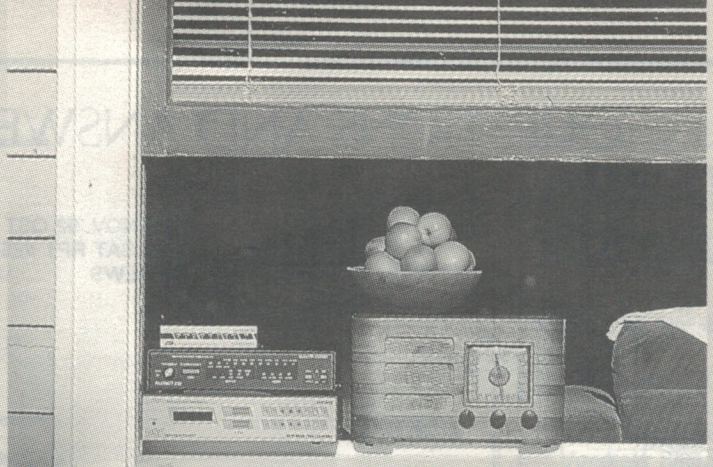
Address.....

City..... State..... ZIP.....

Send this form with payment to AMSAT, P.O. Box 27, Washington, DC 20044.

(shown half-size)

Decal - $2.00



WINDOWS TO THE WORLD.

Pakratt for Windows is the only data controller program for Microsoft© Windows™ on the market today. AEA gives you a true Windows application for controlling AEA's entire family of data controllers, including the new DSP-2232 and the new PK-900.

This graphics-oriented program offers all standard Windows 3.x features (cut-and-paste, custom window sizing and color selection, etc.) and can run minimized or in the background if desired. Also, PC-Pakratt's multi-tasking allows you to run two data controllers simultaneously. Other features include complete parameter screens, binary and ASCII file transfers, macros, QSO logging, comprehensive help and much more.

Get a whole new outlook on ham radio
with PC-Pakratt for Windows from AEA.

Connect with us for your nearest AEA dealer or for a
PC- Pakratt for Windows fact sheet.
Call our literature request line at (800) 432-8873.

Advanced Electronic
Applications, Inc.
PO Box C2160/2006 - 196th St. SW, Lynnwood, WA 98036
Sales: (206) 774-5554

Connect with us